SAE Journal

OCTOBER 1952

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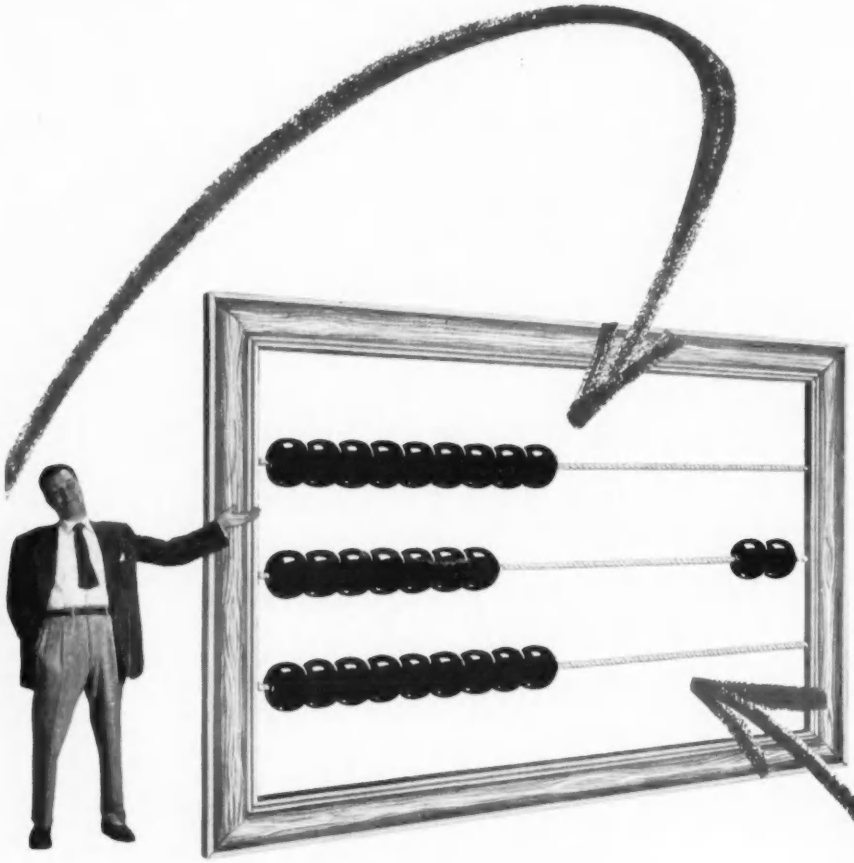

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The application of solid chrome to piston rings, as perfected by Perfect Circle, more than doubles the life of pistons, rings and cylinders. Performance data will be furnished on request. Write Perfect Circle Corporation, Hagerstown, Indiana. The Perfect Circle Co., Ltd., Toronto, Ontario, Canada.

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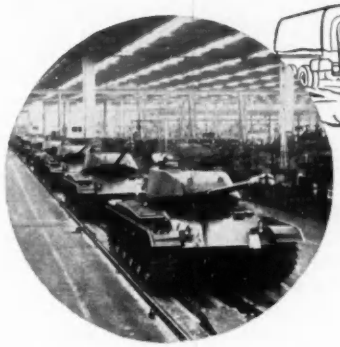

Factory, Farm and Fighting Front...

• On the Korean front, on farms deep in the heart of America, in factories geared to the needs of defense . . . New Departure Ball Bearings are worthy warriors.

• Back of the implements of War and Peace stand the machines that produce them. Designers and builders rely on New Departure to simplify production problems. For instance, Sealed-for-Life bearings, originated by New Departure, eliminate separate seals and lubricating fixtures.

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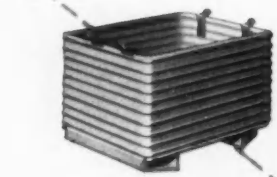

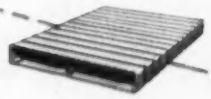

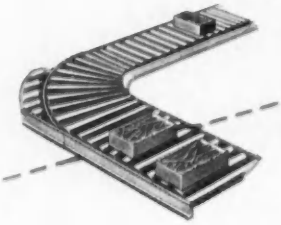

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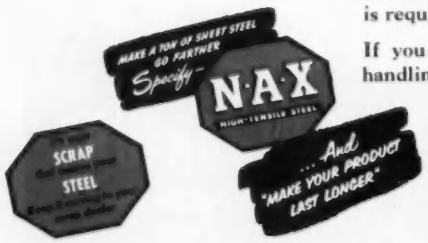
If you are interested in better, more economical materials-handling, why not investigate N-A-X HIGH-TENSILE steel *now?*



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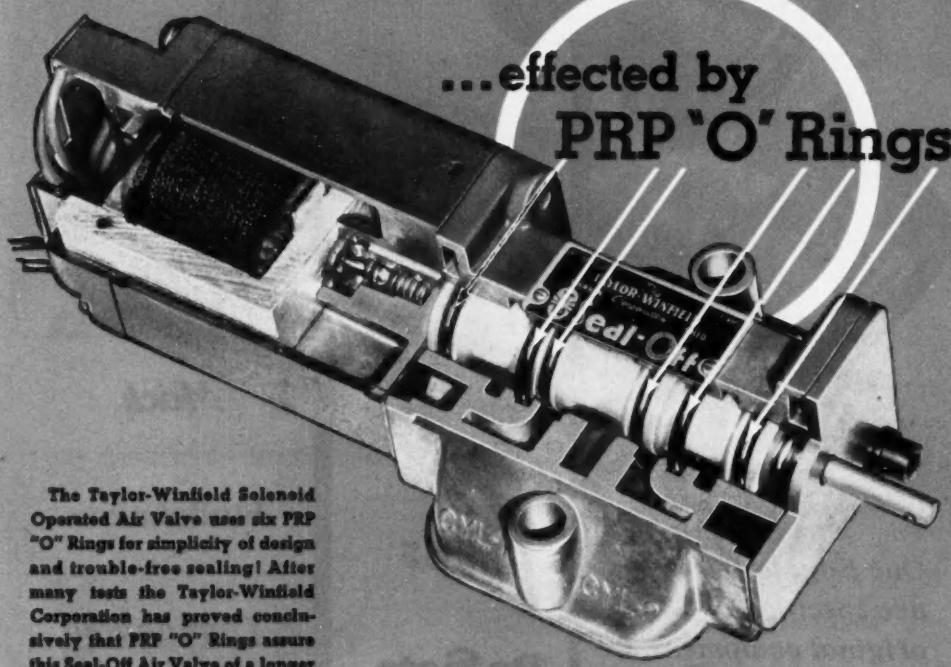
...effected by PRP "O" Rings



The Taylor-Winfield Solenoid Operated Air Valve uses six PRP "O" Rings for simplicity of design and trouble-free sealing! After many tests the Taylor-Winfield Corporation has proved conclusively that PRP "O" Rings assure this Seal-Off Air Valve of a longer operating life at higher rates of intermittent or continuous duty performance.

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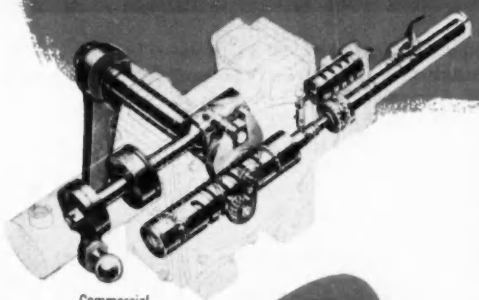
Ross HYDRAULIC POWER STEERING . . . SINCE 1942



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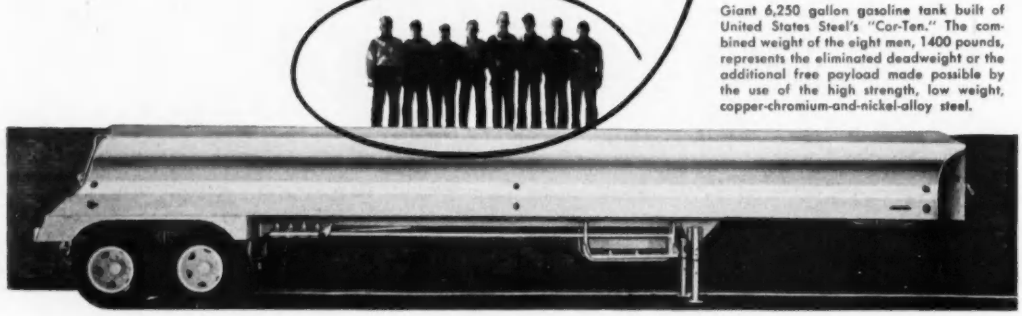
HOW THE DEADWEIGHT OF EIGHT MEN

1400 lbs. is converted to payload BY "Cor-Ten" Steel



Giant 6,250 gallon gasoline tank built of United States Steel's "Cor-Ten." The combined weight of the eight men, 1400 pounds, represents the eliminated deadweight or the additional free payload made possible by the use of the high strength, low weight, copper-chromium-and-nickel-alloy steel.

230 gallons of gasoline are transported free everytime this 6,250 gallon trailer tank rolls out on the road for The Trailmobile Company, Inc., of Springfield, Missouri.

Why? Because this extra payload replaces the 1400 pounds of deadweight eliminated in construction by using "Cor-Ten," a low-alloy steel.

"Cor-Ten," a steel containing copper, chromium and nickel, has high strength, higher than carbon steel, which makes possible the use of lighter gauges with a saving in deadweight.

"Cor-Ten" steel also has the abrasion, corrosion and erosion resistance so essential for long, trouble-free service life.

What's more "Cor-Ten" (like the many other trade-named high strength, low alloy steels containing nickel) is easy to work with. It forms without difficulty and welds readily without special treatment.

Does such lightweight, high strength steel offer you the possibility of maintenance and shipping cost savings? Then investigate the trade-named high strength nickel structural steels.

At the present time most of the nickel produced is being diverted to defense. Through application to the appropriate authorities, nickel is obtainable for the production of engineering nickel alloy steels for many end uses in defense and defense supporting industries.

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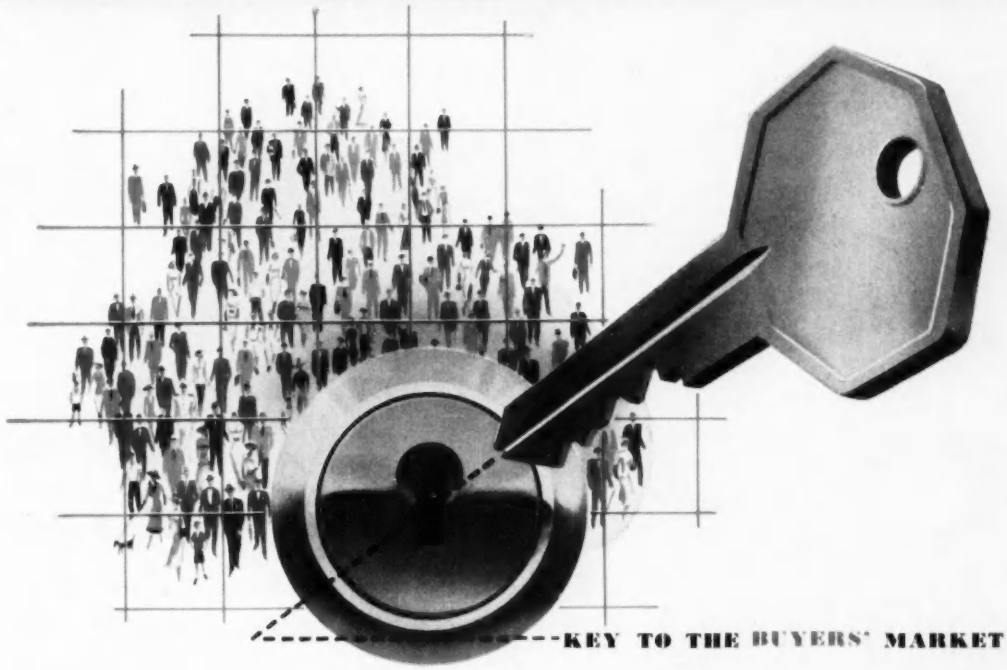

When demand begins to sag and competition grows keen, value becomes the key to the buyers' market.

Automotive value is a complex thing, made up of design, quality, performance and many other factors.

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If you have need for experimental or short-run dies, it can be to your advantage to give serious consideration to Allite Dies—produced by Richard Brothers Division where plaster pattern, modern foundry, and extensive die shop facilities are fully coordinated. Why not write today for full information.

*ALLITE DIES are accurately cast for low cost tooling. The material used is any formula of zinc alloy (Kirksite, Formaloy, etc.) which meets your requirements.

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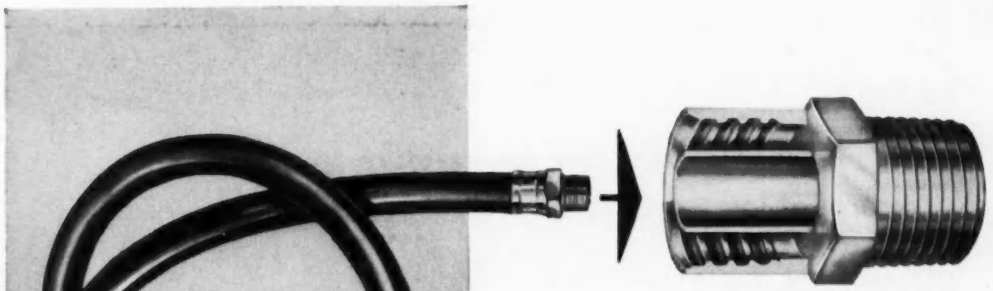
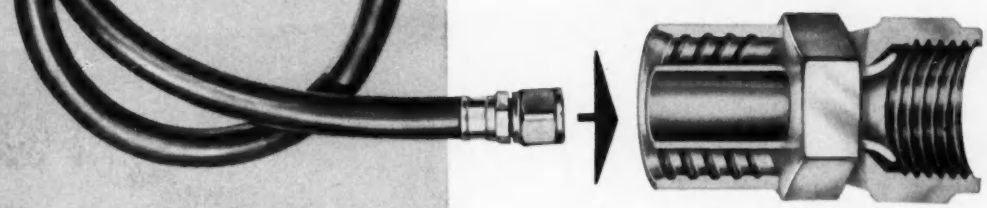


Flex-o-Tube Hose, and cross section of machined male fitting.

FLEX-O-TUBE ...finds brass makes fine fittings



Cross Section of machined and flared female fitting.

For quick, accurate and economical machining, free-cutting brass rod is preferred by many companies, such as Flex-O-Tube, Division of Meridan Corporation, Detroit, Mich. This company makes hose assemblies and fittings to conduct air-oil-water-gasoline and hydraulic power for the automotive, farm implement, machine tool and aircraft industries. Some of these hoses have a minimum bursting pressure of 20,000 pounds per square inch, which gives an indication of the tightness required, which can be obtained only by strength and accuracy.

Flex-O-Tube has found six points of superiority for brass over other metals, as follows:

1. Brass "flows," or is ductile, so that no cracks result during the crimping operation required to fasten the fittings to the hose.

2. Ductility and strength inherent in brass act to provide a superior seat to fittings designed to control fluid flow. Competitive metals are either too hard or too soft to give positive closing and tend to leak.

3. Where the design of the fitting is intricate, necessitating removal of considerable metal by machining, the automatic screw machines can be run faster with free-cutting brass rod.

4. Brass has a high scrap value, and the scrap sold back to the mill increases brass supplies.

5. The break-even point between brass and other metals is especially favorable to brass in the sizes of rod that Flex-O-Tube buys.

6. Customer preference is for brass, which is universally recognized as a quality metal. Hence brass fittings are more readily sold, and in fact often are specified regardless of size or price differentials.

Included in the Flex-O-Tube operations are machining, flaring, crimping, and annealing to assure the proper ductility for flaring and crimping.

Revere is an important supplier of brass rod to Flex-O-Tube, and has also collaborated with this customer through the Revere Technical Advisory Service.

If you wish information about brass and how one or more of the Revere brasses can add to the economy and saleability of your product, get in touch with the nearest Revere Sales Office. See your telephone directory or write direct.

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SOLUTION:

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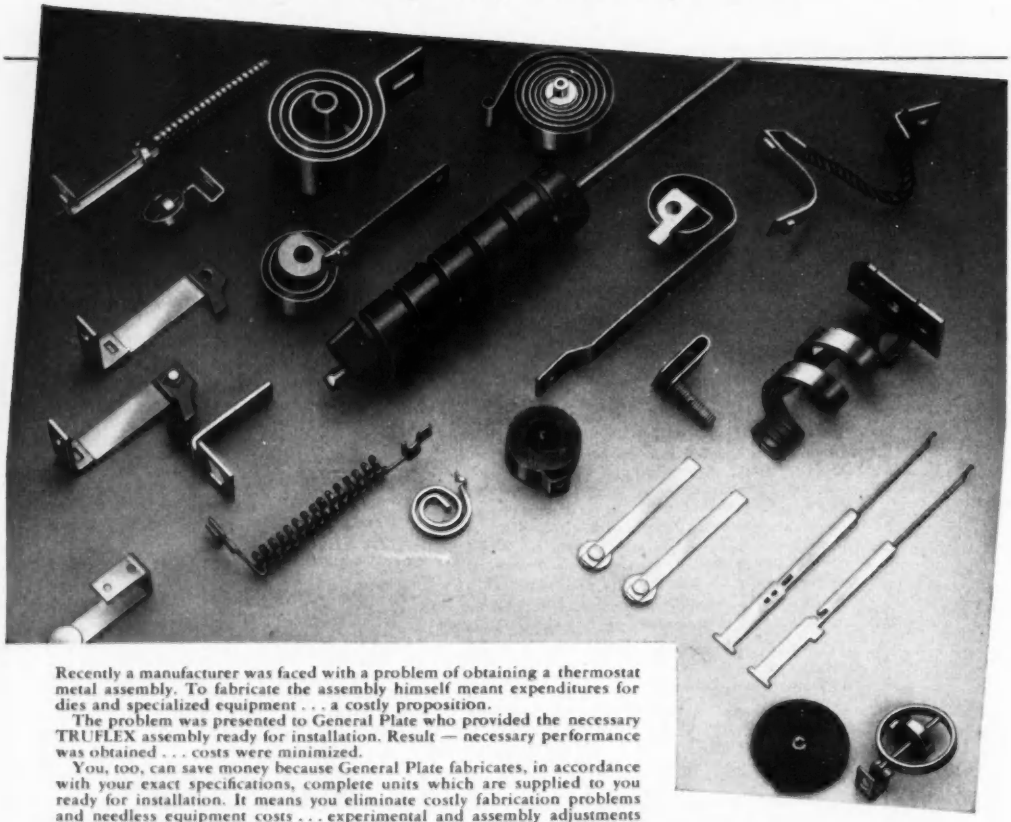

Recently a manufacturer was faced with a problem of obtaining a thermostat metal assembly. To fabricate the assembly himself meant expenditures for dies and specialized equipment . . . a costly proposition.

The problem was presented to General Plate who provided the necessary TRUFLEX assembly ready for installation. Result — necessary performance was obtained . . . costs were minimized.

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You get reliable performance because every order comes to you an exact duplicate of the original . . . consistently uniform in tolerances, temperature reaction and performance, thus preventing rejects and costly adjustments in assembly.

General Plate TRUFLEX Thermostat Metal Assemblies will be made to meet your specification requirements for temperature range, electrical resistance, corrosion resistance, etc. However, if you prefer to make your own assemblies, General Plate will produce sheet or strip to your material specifications. Write for information or engineering assistance.

Have You a Composite Metal Problem? General Plate can solve it for you

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For the Sake of Argument

It's the Little Things that Count . . . . .

By Norman G. Shidle

Our jobs, indeed our lives, are made up mostly of little things. Even the occasional problem big enough to shake our own little world usually is many-faceted, a combination of little things.

For one important decision that has to be made or task to be done, most of us face thousands of minor ones. More than 90% of our working hours are taken up with short-objective small operations.

That is what makes a fellow's attitude toward little things so important. . . . Either he gets satisfaction from doing well his small jobs, or lives a life nearly barren of satisfactions. Put together, his functioning on one after another of everyday tasks, spells a good job or a bad one.

Even the biggest executive rarely stays big unless he understands the daily, little items which he must sort out and add up to make big decisions. When the little figures get blurry, it's terribly easy to make a mistake in addition.

The fellow who regards little things as interruptions to his attack on big ones is constantly being interrupted. Better off is the man who trys to make small solutions steps toward solving the big problems worrying him.

To do this, of course, requires a clear concept of his big problems, his major aims. It requires, too, a constant, conscious awareness of possible relationships between the immediate problem and his permanent, broad objectives.

The old story of the three masons asked "What are you doing?" is pertinent to our view of little things. One, you recall, answered: "I'm putting stones together." The second, "I'm working on a wall." . . . and the third, "I'm building a great cathedral."

From one point of view, there *are* no little things.

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***Parco Compound**—rust resistant . . . used on iron and steel articles, small and large, simple and complex.

***Parcolacs**—group of specialized products made up of various finishes for use after Parco Compound . . . includes wax base finishes, stains and rust preventive oils.

***Parco Lubrite**—wear resistant for friction surfaces . . . used to create a nonmetallic phosphate "break-in" coating on gears, cylinder walls, pistons, rings, shafts, valves and rods.

***Parco Prime**—corrosion resistant paint base for use on structural steel and custom fabricated articles too large to process by conventional methods . . . single coat, spray or brush applied, creates uniform prime coat on iron and steel.

***Parco Black**—corrosion resistant coating which provides a jet black finish on iron and steel parts in a single bath. Used on nails, nuts and bolts, tools, hardware.

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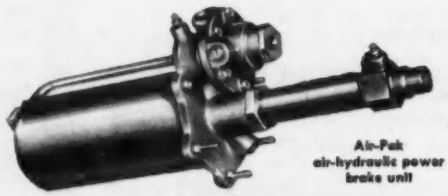
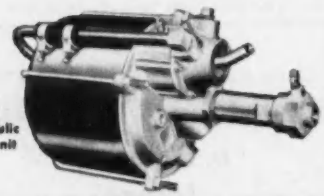
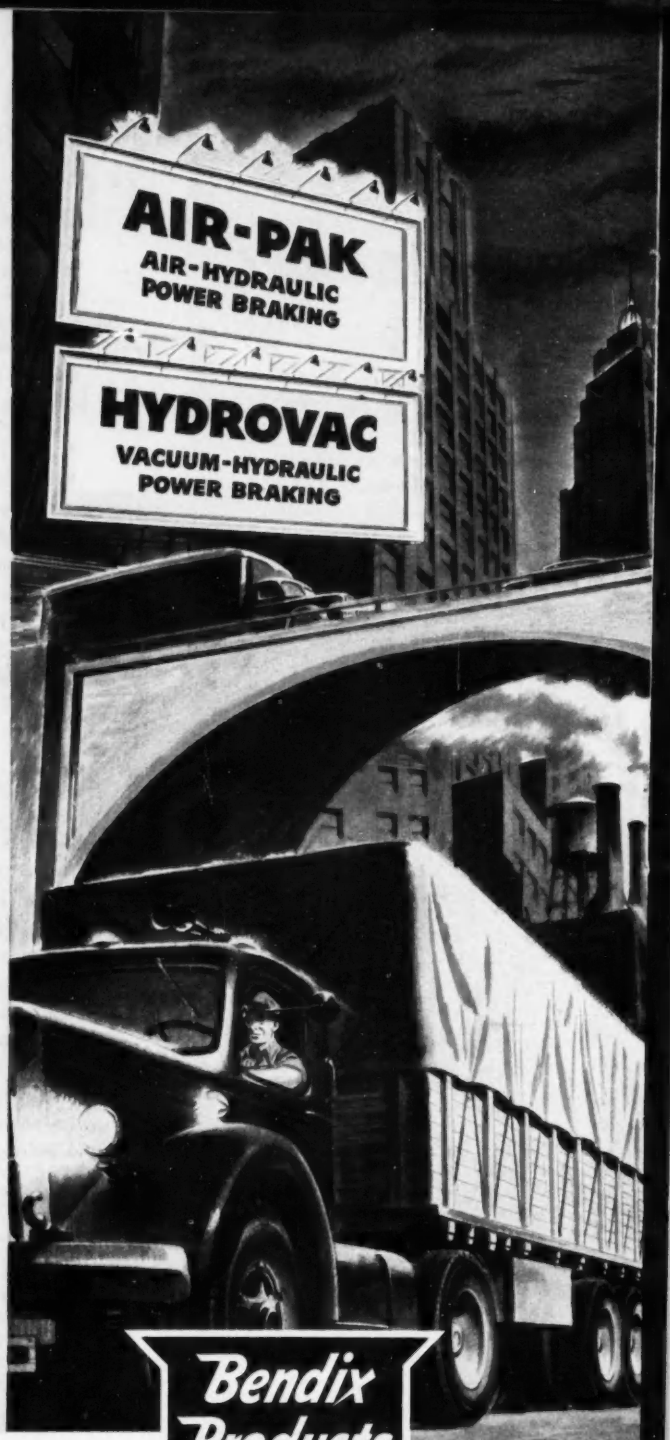


Air-Pak air-hydraulic power brake unit



Hydrovac vacuum-hydraulic power brake unit



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Years, Ideas, and Engineers

Stanwood W. Sparrow

This paper was prepared by the late Stanwood W. Sparrow, vice-president of engineering, Studebaker Corp., and Past-President of SAE, for presentation at the SAE Banquet at the Centennial of Engineering, Hotel Knickerbocker, Chicago, Sept. 4, 1952.

OUR title points the direction our thoughts are to travel without imposing limitations as to route. But the event which prompts this meeting does suggest that we concentrate our attention on events between 1852 and 1952. And since my own bifocals are discolored from long exposure to matters automotive, it will not be surprising if much that I see appears to have an automotive tint.

The year 1852 does not mark the dawn of engineering. There must have been engineers almost as soon as there were human beings, if we accept a dictionary definition of engineering as the "conversion of natural products or energy into products useful to man." We might go further; we might consider that the monkey who whacked a coconut against a rock and discovered a product useful to monkeys, should be credited with at least a resemblance to an engineer. Engineers have been accused of resembling monkeys with less justification.

For those who balk at classifying coconut-cracking as engineering, we can offer the pyramids of Egypt as evidence that there were engineers even in ancient days. Our offering may be challenged. The pyramids were constructed to preserve the dead and it might be difficult to prove that such preservation meets the dictionary requirement of being "useful to man." I think that here we must abandon the dictionary definition and agree that the engineer's task is to make dreams come true rather than to create them or pass judgment on their merit. And perhaps we should not look with too much scorn on the desires of the Pharaohs. I am told that near the great pyramid there is a sphinx and that on the face of that sphinx there are traces of a smile. Perhaps that smile was inspired by visions of the atomic bomb and the thought that, after thousands of years of civilization, people should be concerned with the mass production of death rather than with the preservation of its products.

But the sphinx is reputed to be wise and, if so, it knows that so long as humanity has ideas and ideals, it will defend them. We can take pride in the contributions engineering has made and will make to the defense and strengthening of our Nation. Nevertheless our goal is peace and our interest is in what engineering has contributed to man's well-being rather than to his powers for destruction. It is significant that the event we commemorate tonight is the founding of the American Society of Civil Engineers and that the word "civil" was intended to include all engineers whose interests were not predominantly military.

Societies frequently are formed to do or to get something specific. Referring to them, one almost automatically mentions the advantages of "working together." Engineers can and do work together effectively. But in the engineering societies with which I am familiar, the prime objective is not "working together." Our own Society was not founded to bring prestige or plunder to automotive engineers. An engineering society brings engineers together. They ponder their problems; they share their gloom and their glory; they share the knowledge they have and consider how they may obtain the knowledge that they lack. From such association, a member finds that his knowledge is increased, that his morale is strengthened, and that he is better able to render engineering service in his own particular field of endeavor.

It is fortunate that the American Society of Civil

Engineers was founded in 1852, for, in the century to follow, engineers could make full use of whatever added to their knowledge or strengthened their morale. A few years later, a President's name would make official an Emancipation Proclamation bringing to a few people freedom from slavery and new opportunities. But, throughout the century, it would not be the names of engineers but their intelligent efforts that would bring to many people freedom from drudgery and opportunities unlimited.

Suppose now that we take a hasty glance at those years. We shall not attempt to analyze their significance or to select events of major importance. Our aim is to provide the sort of background one might offer to a Rip Van Winkle who had fallen asleep after celebrating the founding of the A.S.C.E. and had awakened to the tumult of the 1952 Presidential campaign.

1852

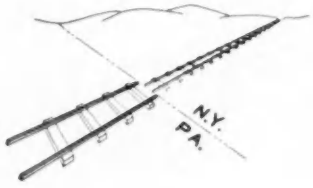
A lamp chimney is invented.

Already engineers are concerned in the utilization of petroleum products.

Elevator with safety appliances is invented by E. G. Otis.

People wish to travel up and down as well as back and forth, but they insist on safety.

To prevent the Erie Railroad from passing through its state, Pennsylvania adopts a railroad gage different from that of New York.



The advantages of standardization and cooperation are not yet universally appreciated.

A blacksmith shop in South Bend begins to build wagons.

Throughout the next 100 years, Studebaker was to continue to build vehicles for highway transportation.

1853

The War Department is authorized to make a study of practicable, transcontinental railroad routes.

The importance of transportation in time of war is recognized.

1854

The Republican party makes its debut at Jackson, Michigan.

This party was to grow in strength and some of its candidates actually reached the White House.

1855

The Niagara Falls suspension bridge built by John Augustus Roebling is opened.

Upon recommendation of the Secretary of War and with funds appropriated by Congress, 33 camels are brought from Egypt to the desert sections of the Southwest.

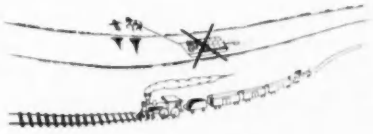
Other forms of transportation have since been found suitable for these areas.

1857

Nationwide celebration commemorates connection of St. Louis with New York.

A railroad buys up a canal system to eliminate competition.

Despite its simplicity, the elimination of competition by destruction of a competitor was later frowned upon.



1858

Sleeping car is invented by George M. Pullman.

For years, people had been walking in their sleep, now they can ride.

Marsh patents harvester which gathers grain into bundles.

Miller patents mowing machine.

The Overland Mail stage completes its first trip from San Francisco to St. Louis in 23 days and 4 hours.

The horse still is needed and still provides thrills.

1859

"Pikes's Peak or Bust" is the theme song of the gold rush.

In New York City a new song called "Dixie" is heard for the first time.

Some wish to seek gold in Colorado, others yearn for the land of cotton, but there is a growing desire to go places and interest in all forms of transportation is mounting.

1860

Riders cover distance between Sacramento, California, and St. Joseph, Missouri, in 10 days as Pony Express is inaugurated.

Horses are still in the spotlight.

1861

Yale establishes Sheffield Scientific School and Massachusetts Institute of Technology is incorporated in Boston.

Engineering had been taught at West Point since 1802 and engineering courses were being offered by Rensselaer Polytechnic Institute in 1852. Now the need for engineering training is becoming more widely recognized.

President Lincoln declares that "insurrection" exists.

Men and horses are to play the chief roles in the war to follow. Railroads will be used when available and the introduction of iron-clad gunboats will foretell the changes that are to come in ship construction.

1867

The first elevated railroad in the United States is put into operation in New York City.

1868

Westinghouse air brake adds to safety and practicability of rail travel.

1869

A golden spike at Promontory Point, Utah, completes rail connection between Atlantic and Pacific.

Princeton and Rutgers play first intercollegiate game of football in United States.

The Civil War is over but bitter intersectional rivalries remain. The future will see some of these rivalries settled in bowls instead of on battlefields with casualties confined to coaches of losing teams.

1871

Five Korean forts are destroyed by United States Navy in vain effort to secure treaty relations.

It takes a long time to settle trouble in Korea.

1872

First mail-order house, Montgomery Ward and Company, opens in Chicago.

Believe it or not, the first catalogue consisted of a single sheet.

1873

Cable-cars appear in San Francisco.

1874

Atlantic Coast states are plagued by potato bugs.

The urge to travel is in the air but not all travellers are welcome at journey's end. The potato bugs have come from the Rocky Mountains and, though the miles have been many, they arrive free from fatigue.

1876

American Chemical Society is organized.

Telephone transmits first complete, intelligible sentence—"Mr. Watson, come here, I want you."

There are to be great developments in telephone communication, but there will always be the danger that the party at the other end of the line will want something.

1879

Edison invents incandescent lamp.

First Woolworth five-and-ten-cent store opens.

In 1879 a nickel will buy something.

1880

American Society of Mechanical Engineers is founded.

Broadway is illuminated by arc lights for a full mile.

1883

Congress authorizes the construction of 3 steel cruisers and 1 dispatch boat—the beginning of a steel navy.

Brooklyn Bridge is opened.

Standard time zones are established for entire country.

This eliminates the confusion that has existed previously. It makes it possible to create really complicated confusion by the introduction of Daylight Saving Time.

1884

American Institute of Electrical Engineers is founded.

A building 10 stories high, probably the first sky scraper, is erected in Chicago.

1886

Charles M. Hall discovers process of extracting aluminum from ore.

This discovery gives us a material which is to make many things possible, including years of arguing over the respective merits of aluminum and cast iron pistons.

1888

Eastman Company puts film-roll camera on the market.

"Bobbie" Burns had longed for some power "to see ourselves as others see us." Now we can—and often do—and it is very discouraging.

1889

Bicycle with wheels of equal size is introduced.

This is low-cost personal transportation, and though it depends upon manpower, it is better than walking. Four years later there are to be more than a million in use.

The Australian ladybug is brought to California to destroy the white scale which threatens the citrus industry.

"Never underestimate the power of a woman."

1891

Empire State Express travels 436 miles in 426 minutes.

Whitcomb L. Judson patents the zipper.

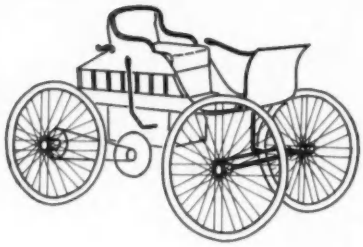
Feuds, fights, and civil war have torn our people asunder, but—thanks be to Judson—we now have something to hold them together.

1893

Duryea brothers produce America's first gasoline-engine-propelled motor vehicle.

1894

One cylinder, one horespower car dashes over Pumpkin-fine Pike in Kokomo at speed of 6 miles per hour. The car was built for Elwood Haynes by the Apperson brothers.



1895

J. Frank Duryea wins America's first motor vehicle race. Despite snow drifts, the Duryea Motor Wagon completes the 52.4 mile course at an average speed of better than 5 miles per hour.

1896

Charles King drives first car on streets of Detroit.

Henry Ford operates his first car in Detroit.

R. E. Olds drives one cylinder car in Lansing.

Alexander Winton produces experimental car.

Mass production of automobiles is inaugurated as Duryea Motor Wagon Company builds 13 cars from the same design.

Samuel P. Langley demonstrates principle of air flight by flying heavier-than-air model airplane 300 feet.

First public showing of moving pictures is made.

Now people can sit in comfort and watch the landscape bounce up and down or they can sit in the new horseless carriages and let the landscape watch them bounce up and down.

1897

First subway in the United States is completed in Boston.

The "Proper Bostonian" becomes aware of the hazards of bicycles and horseless carriages, but he doesn't leave Boston. He goes underground.

1898

War with Spain is of short duration.

1900

There are now 8000 automobiles in the United States.

1902

The Flatiron Building, 20 stories high, is completed in New York.

1903

An Oldsmobile and a Packard are driven from San Francisco to New York.

At Kitty Hawk, Orville and Wilbur Wright make successful airplane flights. Orville flies 120 feet in 12 seconds and Wilbur 852 feet in 59 seconds.

1904

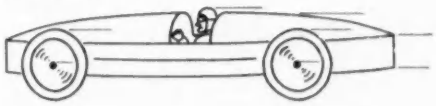
Henry Ford drives "999" a mile at 91.37 miles per hour.

1905

Society of Automobile Engineers is formed.

1906

At Ormond Beach, a Stanley Steamer goes a mile at 127.66 miles per hour.



1907

Oldsmobile adopts nickel plating for trim parts.

Glitter comes and glitter is destined to remain.

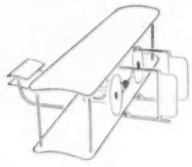
Glencoe, Illinois, builds humps into its streets to curb speeding.

Streets still have humps but they no longer are premeditated.

1908

Tunnels under East River and under the Hudson are opened to traffic.

Wilbur Wright flies 77 miles.



Cadillac wins Dewar Trophy for interchangeability of parts.

1909

Peary reaches North Pole.

For some puposes dog-power is superior to horse-power.

1910

Speaking in Kansas, Theodore Roosevelt declares, "I stand for the square deal."

The years to come were to bring the New Deal and the Fair Deal. The I-deal is yet to come.

1911

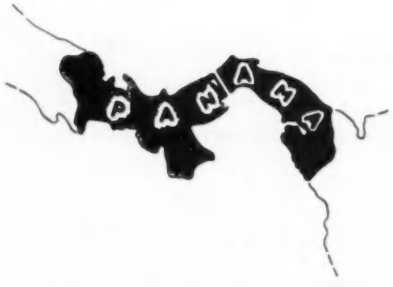
Cadillac adopts electric starter developed by C. F. Kettering.

Marmon "Wasp" wins first 500-mile Indianapolis Race.

First transcontinental flight from New York to Pasadena begins on September 17th and is completed on November 5th. The actual flying time is 3½ days.

1914

Panama Canal is opened to traffic.



1917

Society of Automobile Engineers becomes Society of Automotive Engineers.

Proclamation of war with Germany.

On September 12th, Secretary of War Baker announces that the Liberty Engine has passed its "perfection" test.

Imagine the product of an engineer being credited with perfection!

1918

Armistice is declared.

Daily airmail service begins between New York and Chicago.

1923

Gasoline containing tetra-ethyl lead is placed on market.

1927

Lindbergh flies from New York to Paris.

1941

United States declares war on Japan, Germany, and Italy.

This was to be a mechanized war and automotive engineers were to make important contributions to victory.

1945

V-E and V-J days end long and costly war.

Arguments as to who won the war never end, but the automotive industry contributed to the armed services of the United States and its allies:

92% of scout cars and carriers
87% of aircraft bombs
85% of steel helmets
75% of aircraft engines
57% of tanks
56% of carbines
50% of diesel engines
47% of machine guns

1947

William P. Odum completes round-the-world flight in 73 hours, 5 minutes and 11 seconds.

And Jules Verne's "Around the World in 80 Days" was considered fantastic fiction.

1949

Air Force Superfortress, Lucky Lady II, completes first round-the-world non-stop flight.

Jet bomber crosses United States at speed of 607 miles per hour.

1952

It is announced that a plane has flown at nearly double the speed of sound.

A short time ago the public was thrilled to learn that it was possible to travel faster than talk. Now we are on the verge of travelling faster than double-talk.

This century has had years of war and years of peace. It has had depressions and periods of prosperity. But through it all there has been a rapid and continuing growth of travel, transportation, and industrial development. Engineers are credited with having contributed to that growth. The demand for engineers has increased, which indicates that some people believe them to be useful. Suppose now that we consider some of the characteristics of engineers and see if we can find any justification for this belief.

An engineer starts with the idea that something can be done. This isn't blind optimism. The engineer respects facts and when these show the road ahead to be impassable, he makes a detour. But he keeps going, he keeps moving toward his destination, and the knowledge that the path has not been travelled before is an incentive and not a source of discouragement.

"Thinking a thing through" is a good idea but the engineer considers "getting started" a better one. Putting lines on paper, cutting chips, cobbling up something—these are stimulants to the painful process of thought. Santayana tells us that "our knowledge is a torch of smoky pine that lights the pathway but one step ahead." The engineer grabs the torch and takes the step with the idea that he will then be able to see where to take the next one.

The engineer is impatient. He yearns for complete knowledge, he searches for it—but he doesn't wait for it. Knowing *what* works, he uses that knowledge, wistfully hoping that someday he may learn *why* it works. The engineer seeks perfection but he is aware that there are such words as "adequate" and "better" as well as "perfect" and "best." The perfect automobile has yet to reach the highway, though specimens have been seen in advertising literature. Yet millions of people have backed with cash their conviction that a less-than-perfect motor car is preferable to walking.

Another idea that the engineer has gotten into his head is that times change and that what was best in 1895 may not be best in 1952. He knows, for example, that the pioneers were responsible for the design of nearly every part that went into their cars, but he knows that the automotive industry is no longer a one-man show. He realizes that he must work with others; that he is part of a team; and he gives as much thought to team play as to individual performance.

"He is convinced it's a good idea to share his engineering knowledge."

He has another idea which he can't quite explain. He is in an industry that is keenly competitive; as part of a team he is eager for his team to win. And yet he is convinced that it is a good idea to share his engineering knowledge even to the extent of sometimes helping the fellow on the other team. He has sort of reasoned it out this way: You must have good teams to have a good game; the game must be good if it is to please the cash customers; the cash customers must be pleased if there are to be profits; and there must be profits if the game is to be kept going.

No engineer in these United States has the idea that he invented the form of government or the economic system under which he works. He is aware that progress in this Country has been great and he has an idea that he knows why. Kipling foretold the day when "no one shall work for money, and no one shall work for fame, but each for the joy of the working." That day has not arrived and, until it comes, effort usually will be made in expectation of reward. That reward may be money, a medal, a title, or—under a tyrant—merely absence of punishment. But the more direct and just the reward, the greater will be the incentive to effort. The virtue of our economic system lies in its directness. Those who contribute to the success of an industry share in its prosperity. The share may not always match the contribution, but the more direct and just it is, the greater will be the prosperity and the longer will our economic system survive.

Perhaps the characteristics that have been mentioned may not explain the usefulness of engineers, but the fact remains that engineering has been essential to this century's growth and progress. I am not too fond of that word "essential." Some of you may remember the story in the old school book which began with the faulty installation of a horseshoe and ended with a battle that was lost—"all for the want of a horseshoe nail." That story may have convinced you that a horseshoe nail is essential, but I doubt if it aroused in you any desire to be one. Engineers are more important than horseshoe nails. An engineer creates something that is needed or desired. To produce, and to use, that which has been created, a multitude of industries may come into being. It happened with the automobile.

Folks liked those early automobiles and soon found that they filled a need. Now, a half-century later, we are told that automotive products account for one out of every five retail sales dollars. The industry draws its material from all over the world. Three-quarters of all the plate glass and four-fifths of all the rubber go into automotive uses. For low cost, cars must be built in large quantities. This creates a demand for multi-purpose machines with engineers to design them and factories to produce them. Specialization makes for low cost and the automobile manufacturer is not likely to produce his own cotter pins or light bulbs. To supply such parts, other industries enter the picture. At first glance an automobile company might appear to be one of those terrifying monsters called big business. Its terrifying aspects vanish when we find that its very existence is dependent upon a multitude of little businesses.

The effects of using the automobile have been equally far-reaching. Automobiles require roads. Today the United States has 3 million miles of highways and it doesn't have enough. Autos, trucks, and buses travel more than a billion miles per day. A gigantic petroleum industry has arisen to supply the need for fuel and lubricants. People and products can be carried from almost anywhere to almost anywhere else and this has had its influence upon where we live and where we work.

Fond parents have been known to encourage their offspring to prepare themselves for the Presidency. It is a laudable aim. We need good Presidents and the Presidency offers great opportunities. There is one drawback. Openings are limited and applicants many. Engineering also offers opportunities for service. Openings are numerous and the demand is increasing. Our own Society furnishes an indication of the extent to which the demand has increased in the automotive field. It was organized in 1905 with 30 members. It now numbers over 16,000 with its 50th birthday yet to come.

Originally the Society's activity was confined to passenger cars. Now its formally recognized activities include: air transport, aircraft, aircraft powerplant, body, diesel engine, engineering materials, fuels and lubricants, passenger car, production, tractor and farm machinery, transportation and maintenance, and truck and bus. Some members feel that the list should be increased. After scanning the crowded program of an annual meeting, they feel that some time should be allotted to "inactivity."

The engineer's contribution to progress has been great but it isn't completed. Wordsworth describes the "Happy Warrior" as one

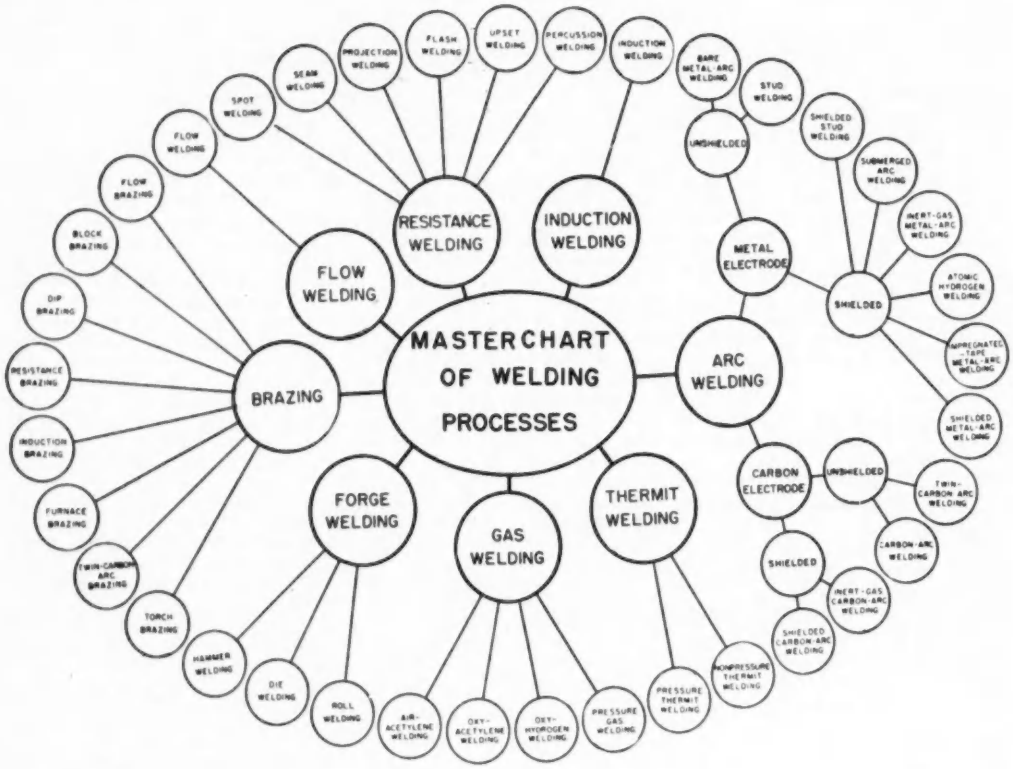
"Who, not content that former worth stand fast,
Looks forward, persevering to the last,
From well to better, daily self-surpassed."

Engineers are not warriors, nor are they always happy. Many admit that several days may elapse before they surpass themselves. But they never have been "content that former worth stand fast" and they do look forward.

And there are times when engineers really are happy. They can laugh, and some can sing, and others do. Way back in 1862, some may have lifted their voices in that song which Julia Ward Howe had just written. You remember how it begins—"Mine eyes have seen the glory—" and then later comes the admonition—"be jubilant, my feet."

Knowledge, training, and hard work account for much that engineers have accomplished, but there was something else. There were eyes that saw the glory that engineering could make possible and feet that moved jubilantly to transform the possibility into an accomplished fact. More glory lies ahead and engineers are still marching.

In selecting one of these methods, here's . . .



WHAT'S the best welding process? It's one that adequately meets service needs of the part in the most economical way. But the best one for any given job has to be selected from some 40 different methods and depends on the specifics of the situation.

Picking the right welding process calls for an evaluation of eight key factors. They are:

1. How was the product engineered and what are its service requirements?

2. What inherent characteristics differentiate the various welding processes?

3. What are the characteristics of the welds made by the various processes?

4. What is the composition of the metals to be welded?

5. What type welding joint design will be used?

6. What will be the production rate?

7. Is there power available?

8. What costs are involved in setting up and operating the process?

How to Pick The Right Welding Process

John J. Chyle, Director of Welding Research, A. O. Smith Corp.

Excerpts from paper "Factors in the Selection of Welding Processes," presented at SAE Summer Meeting, Atlantic City, June 2, 1952.

1. Product's Design: Service Needs Must Be Met

The first consideration must be given to the welded product. Before a satisfactory design can be made, it is necessary to know the service requirements of the product. It is necessary to know the magnitude and distribution of the loads or stresses to be carried; whether oil or water tightness is involved, operating requirements, pressures; what corrosion, if any, will be encountered; the required life of the structure; the appearance requirements, if any; the temperature conditions under which the product will be exposed, and the mechanical properties which are necessary for its successful performance. Only after the service requirements have been given the proper consideration and study is it possible to determine the material which can be used in the most economical manner.

The guide which must be followed in selecting the welding process is that the welded product must have such qualities that the service requirements are adequately fulfilled. What constitutes adequate quality for service requirements is sometimes difficult to determine. Some cases may require extensive investigation.

The operating temperatures will largely determine the composition of the metal or alloy which will be most suitable and economical for the service requirements. The mechanical properties required in the product must be known. That'll help in selecting the welding process which will produce a welded joint to comply with the required mechanical properties. It is important to know the tensile strength, the yield strength, and ductility, as expressed by elongation and reduction of area, of the parent stock and weld metal. Other mechanical properties such as impact strength, notch toughness and fatigue strength may also be of importance, and consideration for these must be given for both weld and the parent material.

With regard to physical properties, it is important to know whether the weld metal must have characteristics similar to those of the parent stock. The physical properties to be considered are: (1) hardness, (2) electrical conductivity, (3) thermal conductivity, and (4) magnetic.

The chemical composition of the weld metal must be considered since in some welding processes the chemistry or composition of the weld differs from the parent stock to a large extent. Where corrosion is an important factor, composition of the weld metal is critical and may vary widely depend-

ing upon the welding process that is used.

The type of loading must be given serious consideration in the engineering design of the product to obtain the proper distribution of stresses. Under severe loading conditions it may be necessary for stress analysists to give consideration to stress distribution so that the most efficient design can be utilized. Under some conditions of loading, it is important that notch effects resulting in stress concentration must be avoided.

2. Process Characteristics: Each Method Has Its Own

A knowledge of the inherent characteristics differentiating the various welding processes is important to the welding engineer so that the most suitable welding process can be selected. Here are a few ways in which they differ:

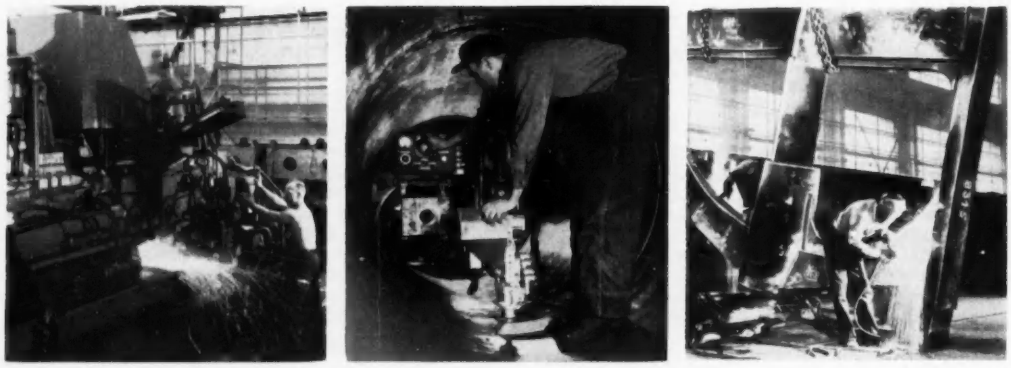
1. Source of heating,
2. Type of shielding,
3. Application of pressure,
4. Addition of filler metal,
5. Completion of the joint,
6. Preparation for welding, and
7. Practical aspects of inspection.

The source of heating characterizes many of the welding processes. Heat from electric power is created by resistance to flow of electric current. This is represented by spotwelding, seam welding, projection welding, flash welding, and upset welding. Heat may also be produced by an electric arc. This is represented in the shielded metal arc welding process, the atomic hydrogen process, the inert gas metal arc process, and the submerged arc welding process. Heat may be created by a discharge of stored electrical energy, and this is illustrated by the percussion welding process.

A second source of heat may be from the combustion of gases, such as oxygen with acetylene, with hydrogen, or with other hydrocarbon gases. The oxyacetylene welding process represents this group.

Heat may also be generated from the combustion

Some Commonly Used Welding Processes



At left is a large resistance flash welder for joining propeller parts. The operator in the center photo is using automatic submerged arc welding equipment inside a pressure vessel. The large ship stern at right is being welded manually by the shielded metal arc process

of coal, carbon, or other solid combustible material. Forge welding is an example where charcoal, coke, or coal is used for heating the metal parts up to a welding temperature.

Heat may also be created by a chemical reaction, which is illustrated by thermit welding. In this process the heat generated is caused by the chemical reaction taking place between aluminum powder and iron oxide.

Welding processes can also be differentiated by the type of shielding used to protect the molten metal from contamination with atmospheric gases. For many welding processes, shielding of the hot weld metal must be adequately effective to preserve the metallurgical quality of the weld, preventing any deleterious action of oxygen and nitrogen in the air combining with the weld metal. Weld metal may be shielded by gases, liquid flux, or solid granular flux.

Making Molten Metal Inactive

The protection of the hot metal against contamination is usually accomplished by gas shielding. Inert gases such as helium and argon are extremely effective in protecting the molten metal from oxygen and nitrogen in the atmosphere. Reducing gases such as hydrogen and carbon monoxide can also be effectively used to prevent oxidation and nitriding of the molten metal. A good example of reducing gases is the atomic hydrogen process, which is used for welding stainless steel, aluminum, and many other metals where protection against oxygen and nitrogen is extremely important.

In the bare metal arc welding process, no special gas for shielding is used; and molten metal is exposed to the atmosphere.

Another method of shielding is by liquid fluxes. In the oxyacetylene brazing process, the flux is applied as a solid material and is converted to a liquid by the heat of the welding process. This liquid on top of the molten metal shields the metal against contamination from the atmosphere.

Still another method of shielding is by the use of solid granular flux material. The process which uses this type of shielding, and is widely used, is known as the submerged arc welding process. In this process the oxygen and nitrogen of the air are excluded by the granular flux surrounding the molten metal. In the arc zone the granular flux becomes a molten blanket covering the hot weld metal and protects it from the oxygen and nitrogen of the air.

Welding processes also are characterized by the application of pressure. Processes differ according to the method of pressure application. In some processes pressure is an important factor in the welding operation, while in others pressure is not required. Flash welding is a process in which pressure is of prime importance.

Processes which do not require pressure are, in general, the arc welding processes such as the shielded metal arc, inert gas metal arc, and submerged arc.

All of the resistance welding processes require pressure. The success and quality of the weld will depend largely on the application of the correct amount of pressure at the proper time in the welding cycle.

In some processes pressure is applied intermittently, while in others it is applied as a single blow, and in still others, the application is constant.

Filler Materials Vary

Welding processes differ radically in the addition or omission of filler metal. In some processes the filler metal is a bare filler wire, as in oxyacetylene and atomic hydrogen welding processes. The metal is added in rod or wire form to fill a welding groove. In the shielded metal arc welding process, the filler wire is a covered metal electrode which is the source of the deposited metal.

In other processes, no addition of filler metal is required. The resistance welding processes are of this type, and include spot, seam, and flash welding.

Welding processes may also be characterized according to the method of completion of the joint. A welding joint may be completed simultaneously or in a progressive manner. Welding grooves may be completed by depositing weld metal in a number of layers, or the entire weld may be made simultaneously in one operation. An example of progressive welding is the welding of heavy sections where a "V" or "U" groove joint is used; the welding is performed with covered electrodes, and is done manually.

In flash welding the entire weld is completed simultaneously by the application of heat and pressure.

Welding processes differ also in the preparations required for welding. For many of the arc welding processes the welding groove must be prepared by either machining or gas scarfing of the joint. For some welding processes the surface of the metal must be clean for good electrical contact, as in resistance welding processes.

The flash welding processes require clean metal surfaces at the electrode contact areas. A contaminated or dirty surface may result in excessive heating at the contact areas and produce defective welds.

How Good Is the Weld?

Processes also differ in the type of inspection methods which can be used to determine welding quality. Welds that are made by any of the arc processes can readily be radiographed and inspected for soundness. Radiographic inspection is not entirely suitable for the inspection of flash welds because the weld is a narrow line. Welds made by some processes can be inspected by magnetic particle examination. In other welding processes this method cannot be used to evaluate the quality of the weld, such as furnace copper brazed joints.

Processes may also differ according to the portability of the equipment used for welding. In some cases large welding machines which can only be installed in permanent locations can be used, while in other cases the welding equipment is of such portable nature that the welding can be performed in any location.

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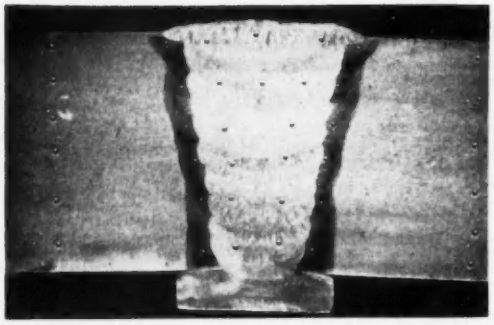
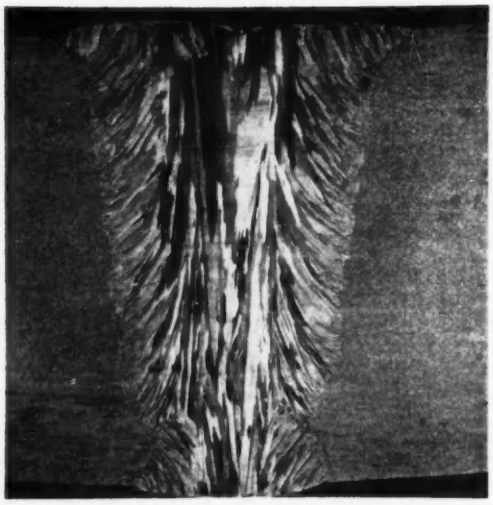
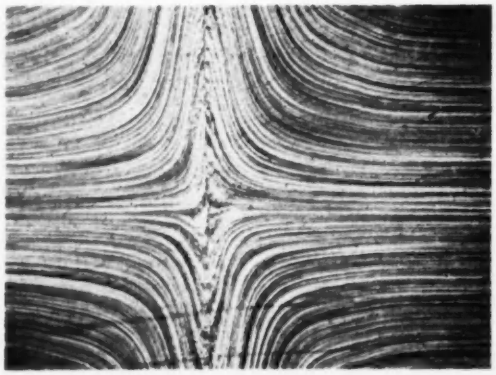
Metallurgy of Welds



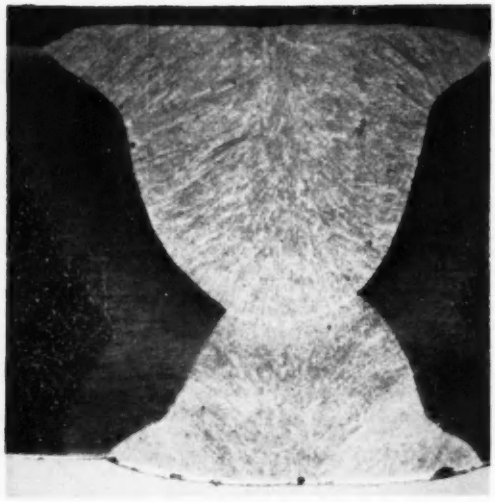
Macrophotograph (actual size) of metal arc weld made by a multiple pass procedure using covered electrodes. Heating the last layer refines the grain structure directly below it, also parent stock adjacent to weld



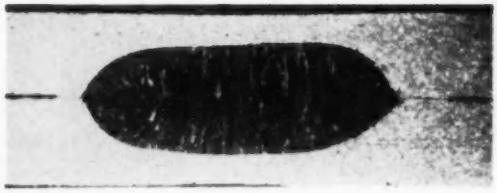
This austenitic stainless steel weld was deposited in multiple passes using covered electrodes. The dendritic structure continues from layer to layer. (This macrophotograph is a 2x magnification)



This cross-section of a flash weld shows that the weld is a line and fusion came about from application of pressure and heat. (Magnified 8x)



The coarse columnar structure was produced by a two pass weld by the submerged arc welding process. Typical of the process, this columnar structure has adequate ductility and strength



Spot welding produces this typical nugget in the welded area. The material is austenitic stainless Type 304 about 0.050 in. thick. (Magnified about 10x)

3. Weld Characteristics: They Depend on the Process

Weld quality characteristics related to the various welding processes are metallurgical, physical, mechanical, chemical, radiographic, weld geometry, appearance, and finishing requirements.

The metallurgical properties of welds made by different processes are shown at left by means of cross-sections of welds.

The physical and mechanical properties of welds may vary according to the welding process which is used. The characteristic structure of a flash weld reveals an out bent fiber condition and the mechanical properties of the weld are similar to the transverse mechanical properties of the parent material. In welds made by any of the arc welding processes, the physical and mechanical properties of the weld can vary widely according to the composition of the weld metal, which is governed by the composition of the filler metal.

Parent Metal and Weld Alike

In the resistance welding processes, the physical and mechanical properties of the weld joint are governed by the properties of the parent metal and cannot be varied by chemical composition. That's because no filler metal is added and the composition of the welded joint is substantially the same as the parent stock.

In the arc welding, gas welding, brazing, and thermit welding processes, the mechanical properties and the physical properties of the weld are influenced directly or widely by the composition of the filler metal that is added to the weld and by the dilution with the parent stock. Consideration must therefore be given to the composition of the filler metal and to the degree of dilution in determining the mechanical properties which will be obtained in these processes.

The physical and mechanical properties of the weld metal can be altered by heat treatment following the welding operation.

The chemical composition of a weld depends to a large extent on the chemical composition of the filler metal, if used, and the degree of dilution with the parent metal. Weld metal chemical composition can vary within large limits in those processes where filler metal additions are used, such as in the arc welding, gas welding, brazing, and thermit welding processes.

Resistance Weld Composition

The composition of welds made by the resistance welding processes cannot be altered unless dissimilar metals are joined together. The composition of the resultant dissimilar metal may vary according to the chemistry of the component parts.

The radiographic quality of the welds made by the various processes may vary according to the process used. It is well known that the bare wire metal arc welds contain excessive amounts of fine porosity. Filler wire compositions and electrode coating compositions also affect the quality of shielded metal arc welds. Flux inclusions and porosity sometimes are found in the welds made by the torch brazing processes.

Joint, Process Set Weld Form

Weld geometry—the form or shape of the weld—depends upon the joint design and the welding process used. The geometry of a weld made by the shielded metal arc process may consist of a symmetrical weld according to the design of the welding groove. Butt welds are used with the arc welding process; the weld is a continuation of the parent plate.

In a resistance spot weld, the geometry of the weld is usually in the form of a nugget joining two separate sections. The geometry of flash welds is entirely different than any other welds and is in the form of a line. The geometry of a copper brazed weld joint differs from others in that it consists of a thin copper weld line, joining the parts.

The outward surface appearance of welds made by the various welding processes differs from process to process. The surface appearance of welds made by the inert gas metal arc process in some metals is clean, bright, and free from oxides, indicating complete shielding from the atmosphere.

The appearance of a flash weld is characteristic of the flash welding process. The extruded metal is rough and irregular and in most applications is removed for appearance or inspection reasons.

Submerged Arc Welds Are Rippled

Submerged arc welds generally can be identified by a very smooth surface appearance. Welds made by covered electrodes in the shielded metal arc process can usually be identified by the ripples on the surface and slag indentations.

The processes differ markedly in the finish requirements that are specified. Flash welds are extremely rough, with the extruded metal presenting an unsightly appearance. In most cases the excess weld is trimmed off to present a uniform weld section.

Other welds do not require finishing other than a wire brushing or the removal of slag which covers the weld surface. Some welds, such as those made by the resistance welding processes, such as spot-welds, do not require any finishing operations.

Turn page for more

4. Metal Composition: Big Factor in Process Choice

The fourth factor to be considered in the selection of welding processes is the composition of the metals to be welded. The composition of the metals to be welded largely governs the selection of the welding process that is applicable for the particular metal. Some metals like carbon steels can be welded by most of the known welding processes. Other metals and alloys of special composition can only be welded by a few of the processes.

Recommendations as to the type of processes which are most generally used are shown in the tables. These recommendations are based on general applications and do not apply to special cases, or where special factors are to be considered.

Titanium and titanium alloys can only be welded at the present time with the inert gas tungsten arc, inert gas metal arc, and a few of the resistance welding processes.

Recommended Processes FOR WELDING METALS AND ALLOYS

WELDING PROCESS	LOW CARBON MILD STEEL	MEDIUM CARBON STEEL	WROUGHT ALLOY ENG STEELS	HIGH ALLOY STAINLESS STEELS AUSTENITIC	STAINLESS STEELS FERRITIC & MARTENSITIC	HIGH TEMPERATURE ALLOYS	CAST IRON GRAY IRON
SHIELDED METAL ARC	R.	R.	R.	R.	R.	R.	S.
SUBMERGED ARC	R.	R.	R.	R.	S.	S.	N.R.
ATOMIC HYDROGEN	S.	S.	S.	R.	S.	S.	N.R.
INERT GAS TUNGSTEN - ARC	S.	S.	S.	R.	S.	S.	S.
INERT GAS METAL - ARC	S.	S.	S.	R.	S.	S.	N.R.
FLASH WELDING	R.	R.	R.	R.	S.	S.	N.R.
SPOT WELDING	R.	R.	R.	R.	S.	S.	N.A.
GAS WELDING	R.	R.	S.	S.	S.	S.	R.
BRAZING - FURNACE	R.	R.	S.	R.S.	S.	N.R.	N.R.
BRAZING - TORCH	S.	S.	N.R.	S.	S.	N.R.	R.
THERMIT	S.	S.	S.	N.R.	N.R.	N.R.	S.

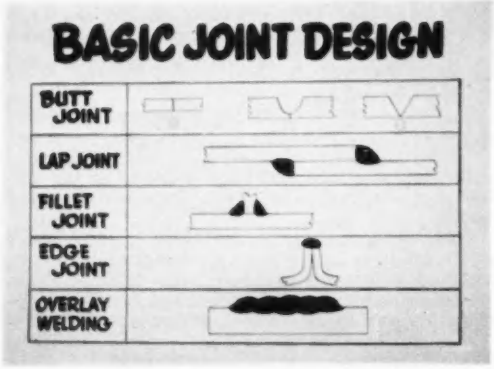
R. = RECOMMENDED S. = SATISFACTORY N.R. = NOT RECOMMENDED N.A. = NOT APPLICABLE

Recommended Processes FOR WELDING METALS AND ALLOYS

WELDING PROCESS	ALUMINUM AND ALUMINUM ALLOYS	NICKEL AND NICKEL ALLOYS	COPPER AND COPPER ALLOYS	MAGNESIUM AND MAGNESIUM ALLOYS	PRECIOUS METALS: SILVER	PRECIOUS METALS: GOLD PLATINUM IRIDIUM	REFRACTORY METALS: TITANIUM & TITANIUM ALLOYS	REFRACTORY METALS: URANIUM MOLYBDENUM VANADIUM ZIRCONIUM TUNGSTEN
SHIELDED METAL ARC	S.	R.	N.R.	N.A.	N.R.	N.R.	N.A.	N.A.
SUBMERGED ARC	N.R.	S.	N.R.	N.A.	N.R.	N.R.	N.A.	N.A.
ATOMIC HYDROGEN	S.	S.	N.R.	N.R.	R.	R.	N.A.	N.R.
INERT GAS TUNGSTEN - ARC	R.	R.	R.	R.	R.	R.	R.	R.
INERT GAS METAL - ARC	R.	R.	R.	S.	S.	S.	N.R.	N.R.
FLASH WELDING	S.	S.	S.	N.R.	S.	S.	S.	S.
SPOT WELDING	R.	R.	S.	S.	N.R.	S.	S.	S.
GAS WELDING	S.	S.	S.	N.R.	R.	R.	N.A.	N.R.
BRAZING - FURNACE	R.	S.	S.	N.R.	S.	S.	N.R.	N.R.
BRAZING - TORCH	R.	R.	R.	N.R.	R.	R.	N.R.	N.R.
THERMIT	N.A.	N.R.	N.R.	N.A.	N.R.	N.R.	N.A.	N.R.

R. = RECOMMENDED S. = SATISFACTORY N.R. = NOT RECOMMENDED N.A. = NOT APPLICABLE

5. Weld Joint Design: Pick It to Suit Process



Another factor which is of importance in the selection of the most suitable welding process is the welding joint design. For most welding designs there are four basic joint types, as shown. These joint types are commonly used in most of the welding processes. These are butt joints, lap joints, fillet joints, edge joints, and overlay welding. Other special types of joints which are commonly used are projection joints, percussion joints, and brazed joints, as shown.

These basic joint designs can only be used with certain welding processes. For example a lap joint cannot be used for flash welding, or a fillet type of weld cannot be made by resistance welding. The recommended processes for various joint designs are shown in the table. This table shows which basic joint designs are applicable to the various processes and thicknesses of material.

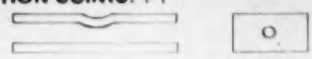
Recommended Processes BASED ON JOINT DESIGN

WELDING PROCESS	BUTT JOINT		LAP JOINT		FILLET JOINT		EDGE JOINT		OVERLAY WELDING
	LIGHT SECTION	HEAVY SECTION	LIGHT SECTION	HEAVY SECTION	LIGHT SECTION	HEAVY SECTION	LIGHT SECTION	HEAVY SECTION	
SHIELDED METAL-ARC (COATED ELECTRODE)	S.	R.	R.	R.	R.	R.	N.R.	R.	R.
SUBMERGED-ARC	S.	R.	S.	R.	S.	R.	N.R.	S.	R.
ATOMIC HYDROGEN	R.	S.	S.	S.	S.	R.	R.	S	R.
INERT GAS TUNGSTEN-ARC	R.	S.	R.	S.	R.	S.	R.	S	R.
INERT GAS METAL-ARC	N.R.	R	N.R.	R.	N.R.	R.	N.R.	S.	R.
FLASH WELDING	N.R.	R.	N.A.	N.A.	N.A.	N.R.	N.A.	N.A.	N.A.
SPOT WELDING	N.A.	N.A.	R.	R.	N.A.	N.A.	N.A.	N.A.	N.A.
SEAM WELDING	N.A.	N.A.	R.	R.	N.A.	N.A.	R.	R.	N.A.
GAS WELDING (OXY-ACETYLENE)	R.	S.	R.	S.	R.	S.	R.	S.	R.
BRAZING-FURNACE	N.R.	N.R.	R.	R.	R.	R.	N.A.	N.A.	N.R.
BRAZING-TORCH	S.	S.	R.	R.	R.	R.	S.	S.	S.
THERMIT	N.A.	R.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.R.

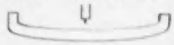
R. = RECOMMENDED S. = SATISFACTORY N.R. = NOT RECOMMENDED N.A. = NOT APPLICABLE
LIGHT SECTION: 0.005" TO 0.125" HEAVY SECTION: 1/8" AND OVER

SPECIAL JOINTS

1. PROJECTION JOINTS. . .



2. PERCUSSION WELDING. . .



3. BRAZING JOINTS . . .

Capillary Action
0.002" to 0.005" Fit

6. Production Rate: Bears on Equipment Used

A factor which is of importance in the selection of the proper welding process is the rate of production. If welded units are made at the rate of 1000 per hr or one per hour, or one per day or per year, the production rate has an important bearing on the selection of the most economical welding process. For most applications the resistance welding processes—where applicable—offer the greatest economy when the production rate justifies the cost of the welding equipment.

Flash welding equipment machines may cost from a few thousand to a million dollars. Unless the production rate is high, the cost per unit cannot be justified. Many products may require a redesign if the production rate is sufficiently high to justify lower cost of welding by adaptation of special automatic welding processes, using high production-rate welding equipment.

7. Power Availability: A Must for Big Machines

Power supply has a bearing on the application of the welding process, since with certain welding processes an adequate amount of electrical power supply must be available.

Some welding processes—such as the shielded metal arc welding process—require a minimum of electrical power, which may vary from 15 to 50 kva. For resistance welding processes, the demand for electrical power is usually of a much higher value and generally for a shorter period of time. The kva power requirements for resistance welding processes may vary from several hundred kva to 8000 kva or more for large flash welding units.

The electrical power for resistance welding is generally controlled accurately in very short increments of time, whereas the electrical power requirement for metal arc welding is generally over longer periods of time and is of a more continuous nature.

Not only is the availability of large amount of power a factor, but also the cost of electrical installations becomes a major cost factor. The power installation requirement for a manual arc welder is relatively inexpensive, while the power installation cost for resistance welding equipment generally is more expensive, and sometimes requires elaborate installation and distribution.

Where power supply cannot be furnished, portable electrical power generating units are available, such as engine driven welding generators.

Turn page for more

8. Economics: Be Sure to Figure All Cost Items

This factor is of greatest importance in the selection of the most suitable welding process, since the basis of selection is for the economical process or method of welding, producing a product that will fulfill the service requirements adequately. The cost of a welding process will depend on preparation costs, setup operation costs, direct welding costs, equipment costs, and finishing costs.

Keep Labor Costs Down

With present inflationary trends and with high labor costs, it is highly important to select welding processes which can be made with the minimum amount of labor. Next best bet is to substitute, if possible, automatic welding operations which will require little or no training of the welding operators. Some welding processes that can be selected may be the most economical from the standpoint of lowest labor costs, but may result in higher material cost, and lower total welding cost per unit.

Preparation costs include the cost of preparing for welding, such as scarfing and surface preparation of the parts prior to welding. The cost of shearing or gas cutting may also be included in preparation costs. In the resistance welding processes it is usually necessary to prepare the surface by removing scale and other foreign material from the surface to be welded to have a uniform condition for resistance welding.

Setup operation costs consist of the cost required for assembling into the welding fixture, the welding of holding lugs to position the parts properly, moving of welding fixtures to the welding equipment, the procurement of welding supplies, and preheating for welding.

Direct welding costs are made up of the cost of labor, material, and power or heat energy for welding.

Labor will include the direct labor charges accumulated in welding operations, the material to be welded, and all items required for welding such as electric power, gases, fluxes, and electrodes.

Depreciation Can Be Sizable

We must include the depreciation and interest on capital investment on the welding equipment used. For many processes, such as the manual arc welding where the investment cost will be in the neighborhood of $1000 or less, the depreciation and interest on capital investment is almost a negligible figure. On the other hand, resistance welding machines such as flash welders, may cost a half million dollars. The depreciation and interest on such a capital investment becomes important and must be considered in the cost of the welding process. Under equipment one must also consider costs of maintaining equipment and the replacement of worn parts.

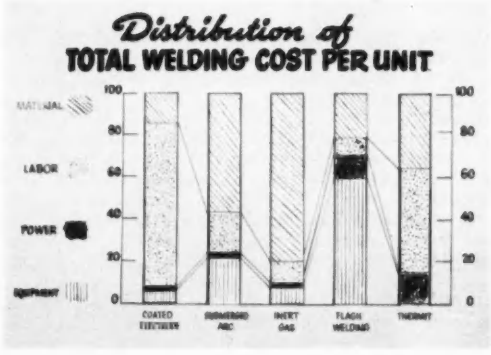
We must also include the cost of removal of excess weld metal and surface finishing such as grinding, polishing, and sandblasting, removal of welding lugs, heat treatment after welding, including stress relieving or heat-treatment to obtain certain mechanical properties in the welded joint.

Under finishing costs also should be included the cost of inspection. This may consist of radiographic or magnetic particle inspection, or some of the non-destructive methods such as supersonic or oil penetrant inspection methods. In other cases where parts are destroyed in the course of inspection, the cost of the loss of such parts must be included in the finishing costs.

Cost Distribution Varies with Process

Shown in the chart are the relative cost per unit including material, labor, power, and equipment costs for five different welding processes. It will be noted that for some of the processes, namely the covered electrode, the labor cost is probably the largest factor in the unit cost of welding. In submerged arc welding, material cost is the largest factor in this comparison. In inert gas metal arc welding, the cost of material is the highest single factor. In flash welding, equipment cost is the largest factor. In thermit welding, the labor and material costs are the large items in the distribution of welding costs.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)



20 Minutes by Car From Britain to France . . . via Air Ferry

Air Commodore G. J. Powell

Managing Director, Silver City Airways Ltd.

Based on paper, "Operation of English Channel Air Ferry," presented at SAE National Aeronautic Meeting, New York City, April 22, 1952.

IN a world of long-range, pressurized operation, a grass-field type of service with a 20-min flight and a block speed of 120 mph may seem very retarded technically. For these very reasons, however, the story of the Silver City air ferry operation may prove of interest.

The ferry operates between England and the continent, transporting automobiles, motorcycles, trailers, and other vehicles, as well as animals and general freight. The grass field at Lympne is the terminal on the English side and Le Touquet, with its single German-built fighter strip runway, is the French terminal. The distance between them is 47 miles.

The operation itself is simple enough—from the motorist's point of view. He arrives at the airport half an hour before his booked departure time, gets his foreign touring documents checked and, with about 15 min to go, takes his car through customs, the baggage remaining in the car.

The car is then driven into the plane, together with the other car and one or two motorcycles that make up the normal load. All the vehicles are then shackled down and the passengers are put aboard.

The tarmac to tarmac time is normally 22 min. This is made up of 2 min taxiing at each end, 3 min in conditions associated with landing and taking off, and 15 min in the air at 160 mph indicated air speed. The flight is normally at the 1000-ft level. At the destination the cars and motorcycles are only 2 min behind the passengers in getting to the

Fig. 1—One type of loading ramp being used for the air ferry operation

customs area and, in most cases, it is perfectly practical to be on the road within 10 min of landing.

From first to last, it takes but one hour for all waiting, formalities, and the crossing itself. The motorist taking advantages of this service saves substantially a day of traveling. He can breakfast in London, lunch at Le Touquet, and be in Paris for tea, with his own car—or he can finish a normal day's work in England and be in France the same evening—or he can leave early in the morning and be deep down in the continent the same night.

Normally, six or seven round trips are scheduled per day per aircraft, although eight can be achieved in the busy season. Six round trips a day mean little more than 4 hr of flying, but are seldom accomplished in an 8-hr period. This is a function not merely of turn-around time. There are other factors, such as the lack of night-flying facilities and the purely freight flights, which are usually with perishable foodstuffs and therefore need careful and, to some extent, slow handling. If the load consists only of vehicles and their passengers, turn-around times are reasonably good, and the controlling factor is not handling the load but the circuit of the pilot through customs, immigration, and the like.

The Aircraft Used

The airplane used is the Bristol Freighter. It is ideal for the present scale of operation. In fact, it needed few changes for this specialized work.

The vehicle hold is 34 ft long and has a headroom of 7 ft. There is an 11-seat passenger cabin at the rear, which is entered by a separate door. The nose opening doors allow external ramps to be placed at the loading sill so that cars and motorcycles can be driven straight onto the field.

The Freighters are fitted with two Bristol Hercules engines, which are rated at 1690 bhp for take-off. Eight such aircraft are in service and six more are on order.

The new ones will be lengthened versions, so that two cars plus a greater number of smaller vehicles and up to 20 passengers can be carried. In addition, a movable bulkhead will be provided so that in the winter months the passenger cabin can be made smaller and three cars can be carried. This is to take care of the increasing number of new cars being delivered to France from England on a 24-hr delivery from the factory in England to the dealer in Paris basis.

Loading Problems

Vital to this operation is a properly shaped loading ramp that will take automobiles under their own power without fouling. This apparently simple requirement has proved remarkably elusive because, although cars have been getting somewhat shorter, the ground clearance has been getting worse—and all loading ramps must, of course, be constructed to take care of the worst case. Until the next low-slung horror comes along the curve position has been temporarily mastered. Fig. 1 shows one approach to the problem.

After the vehicle has been loaded, it must be carefully secured so that it will not move around in flight. Fig. 2 shows how the cross-over chains

are placed on each wheel, to be tightened by quick-action turnbuckles until they bite into the tires.

This method gives the necessary security, but it is rather wasteful of time and labor. Some sort of quick-release able to deal with all wheel sizes and tracks is very desirable, especially for the heavy touring type of motorcycle, which is notoriously difficult to handle.

One difficulty is that the operator cannot deal with a vehicle until the owner has passed it through customs. Loading cannot, therefore, be started until this has happened, and at that point the passenger cannot be kept waiting. A number of attractive schemes could be devised if the vehicles were available even a half hour before departure, but such a luxury in time would be out of keeping with the 20-min journey and an operation that must sell itself by its shortness of total elapsed time.

Weight is not of major concern for, even with two of the heaviest cars on board, there is ample weight margin. For this reason, tables of weights have been compiled for every known make of car in the heaviest trim conceivable and with a further liberal allowance for baggage and possessions. Over and above these provisions the operating gross weight for the plane has been set at some 2000 lb below the allowable figure. Thus, there is no weight problem on these routes. The vehicles don't have to be weighed and neither does the baggage. Most baggage is, therefore, left undisturbed except for customs requirements. Fuel tanks do not have to be emptied—just checked to see that they are not overfilled.

The final loading problem consists of determining the center of gravity. Even though the vehicles are not weighed, this is not particularly difficult. A list of centers of gravity for all makes of cars has been compiled in terms of inches aft of the front axle—the manufacturers having provided most of the figures. With the freight hold divided into marked stations and a suitable slide rule type of trim card, all variations of two cars and other load can quickly be spotted and the center of gravity determined.

Economic Problems

The operation contains all the worst features of ultrashort stage length—and there are only a small number of fare-paying units from which to recover the costs.

First there is the poor utilization in terms of hours per year, for the business is seasonal—and with the present state of legislation there is little opportunity to indulge in off-season bread-and-butter work. During the past year each plane flew on the average between 800 and 900 hr. This is a very low figure by all normal standards, but it involves more than twice that number of landings.

The next bad factor is wear and tear, which is responsible for maintenance and overhaul costs of $43.50 per hr—28% of total operating costs or 22% of total costs, as shown in Fig. 3. This high maintenance cost is not caused by unusual engine expense, for the engines are running 900 hr between overhauls, which is not bad in view of three take-offs per hour.

Terminal costs are the next villains—and the chief of these are landing charges, including a brand new one called pasenger head tax. Fortunately, a reduction in landing charges has been obtained for the short trips, which more or less cancels out the head tax. The total for terminal costs amounts to 31% of total operating expenses, or 24% of total costs.

Because of these adverse factors, the cost per mile for operating expenses is $1.47. When the overhead charges and depreciation are included the cost comes to $1.82 per mile. For the 5-ton load carried, this represents 36¢ per ton-mile.

On the credit side there are, fortunately, some favorable items to offset these heavy costs, the main one being the high load factor and revenue per hour achieved in the midsummer season when the bulk of the traffic comes from the short holiday motorist that books a fixed time to return. During this period a 90% load factor is exceeded for weeks on end.

Another favorable factor is the comparatively small allocation necessary for promotion and advertising and the general costs of selling the service. This is because of the great help obtained from the two principal British motoring organizations where prospective vacationers to the continent have to go anyhow to obtain their customs *carnet*. Thus, publicity can be concentrated in this direction.

The Future

There seem to be two stages ahead, at least in England, in this business. The first will occur when the traffic on short routes is sufficient to justify the use of planes carrying a larger number of units—

Fig. 2—Cross-over chains being used to hold down each car wheel

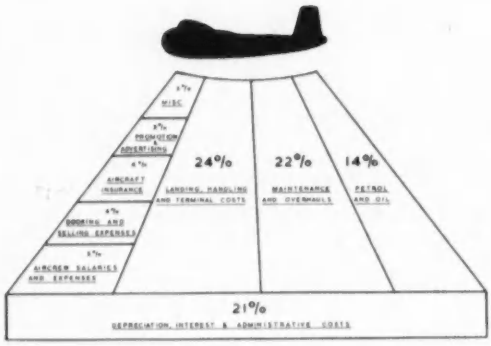


Fig. 3—Analysis of total costs for short ferry routes

and that can be moved away from a coast-to-coast route and operated on a slightly longer stage length. It is believed that it will be economical for the air ferry to operate over a 150-175-mile stage length with a 4-engine, 6-car carrier in three or four years.

Such planes would allow operation from somewhat south of London to an airport north of Paris.

The second stage would occur with the introduction of the helicopter for use on even shorter trips than the present ones—possibly even starting where the road ends on each side of the channel.

This aircraft is conceived of as a double unit, the upper half to house two engines, the rotors, and accessories, and the lower half to hold the freight—a 5-ton container with space for 2 cars and the passengers. It might be possible to have the lower halves loaded and customs cleared before the upper halves come along to make the lift.

It seems as if such a combination would be technically possible within five years and thus be available well within the working life of the aircraft now being used.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Dual Axle Suspension . . .

. . . developed as conversion unit, does away with shock absorbers and permits handling front end loads up to 27,000 lb on single tires without using hydraulic steering.

BASED ON PAPER BY **J. W. Putt** Hahn Motors, Inc.

A DUAL axle suspension, known as the Spangler conversion, is available as a conversion unit for commercial vehicles. The suspension is attached to each side of the chassis frame by a cast steel bracket which has two integral and parallel cylinders mounted vertically and spaced 11½ in. apart. These mate with two inner cylinders mounted on a cast steel bracket.

The inner cylinder mounting bracket is attached to the center of a walking beam by means of a pivot pin. A torque rod pivot pin is located at the bottom of the inner cylinder mounting bracket. The walking beam is a weldment whose two sides and bottom form a "U" section. Two parallel plates are welded in each end of the walking beam, one is flush with the end of the beam, the other is welded 6½ in. from it. At each end a 6½ in. long steel tubing is welded longitudinally to the end plates. Each tubing has a pressed bronze bearing into which an end pin is inserted at each end of the walking beam and while free to rotate the pin is retained.

A standard type shackle bolt is used to attach the end pins to yoke type brackets fastened to the top of the axle. A yoke type bracket is fastened at the bottom of the axle and one end of a torque rod is attached by means of a shackle bolt. A torque rod is attached to each bottom axle bracket and the other end of each rod is mounted on the pivot pin at the bottom of the inner cylinder bracket in the center of the walking beam.

Linkage is in the form of a parallelogram, therefore, regardless of the displacement of one axle relative to the other the vertical centerlines of both axles will always remain vertical. This is also true when any wheel is displaced relative to the other.

Deflections of the coil springs placed in the telescopic cylinders give excellent riding qualities. The deflection from free length to bottoming of the cylinders is 9½ in. No shock absorbers are used. Hydraulic steering is unnecessary with single tires as the vehicle can be steered with one hand at low speeds with loads on the front up to 27,000 lb. With dual tire equipment hydraulic steering is needed.

When both front and rear suspensions are used, the tendency of the frame to twist is greatly reduced. This is reflected in lower maintenance costs for the body or mounted equipment as well as for the chassis. (Paper, "A New Development in Axle Suspension," was presented at SAE Summer Meeting, Atlantic City, June 3, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers).

New Materials:

Inventions Born of Necessity

Joseph Gurski, Supervisor, Materials and Processes, Ford Motor Co.

Report on Round Table on New Engineering Materials was presented at SAE Summer Meeting, Atlantic City, June 3, 1952.

CRITICAL shortages of materials and unreasonable increases in cost of raw materials may be temporarily troublesome and expensive. But in the long run they are very often blessings in disguise.

It can safely be said that shortages speed new developments which result not only in permanent replacement of the original material, but also in lower costs.

- The less expensive boron and lean triple alloy steels will certainly stay with us in many applications long after the emergency is over.

- Synthetic fabrics and rubbers will continue to be used in many applications, even if wool and natural rubber prices permit lower cost of finished parts.

- It is entirely probable that nickel will lose some of its former applications in the plating field to white brass or some other combination of metals.

- Nodular iron is certain to replace more expensive alloy irons in many applications.

These developments are just typical of what is continually happening in industry to combat rising costs. War created shortages merely increase the rate at which problems are solved and technological progress occurs.

The Score on Substitutes

The supply of chromium has been adequate and should continue to be so. Nickel is still critical, with the demand at about twice the supply. There appears to be little chance for relief within the next year, although it is hoped that Cuban ores may ease the situation next year.

Cobalt, columbium, tantalum, and molybdenum remain critical. Some easing has occurred in the first three due to jet engine conservation programs.

The use of boron steels has shown a steady increase and 58,000 tons were made in April. This represents about 11% of the total alloy steel melted. Most of these steels find their use in trucks with leaner triple alloy steels being used in passenger cars.

At the moment boron steels might be considered temporary. However, experience has proved that if this "substitute" gives adequate service over a period of time and is less expensive than the original material, it will stay. Indications are that boron steels are gaining in popularity.

I. Nodular Iron

Nodular iron has better strength and impact resistance than grey cast iron. Its physical properties are comparable with those of high-strength alloy irons and steel castings and it has increased machinability. Nodular iron is a new material and not a substitute.

For any material to be of service to design engineers, it must have consistent physical properties. To develop a process which would insure castings of uniform strength, temperatures had to be accurately controlled, tramp elements had to be kept at a minimum, and a great deal of experimental work was needed with gating and risering techniques.

The shortage of virgin alloy carrier materials for magnesium, such as nickel and copper, necessitated the use of scrap with its attendant tramp elements. This had considerable effect upon process control. Recent developments indicate that carriers other than nickel or copper are satisfactory.

Cost studies have shown that a low sulfur iron produced in a basic lined cupola is desirable because it reduces the amount of magnesium required.

While laboratory testing to insure uniform quality of material is considered very important, field testing as a final evaluation is normally required. Such tests are in progress on caustic pots, clutch pressure plates, crankshafts, and brake drums. To date,

The up-to-date lowdown on new engineering materials given here was developed by this Round Table group. They are (left to right): Chairman V. A. Crosby, Climax Molybdenum Co.; W. J. Simpson, Chrysler Corp., who held forth on new synthetic rubbers; C. F. Nixon, General Motors Research Labs, who talked about new automotive finishes; N. J. Rakas, National Automotive Fibres, Inc., who discussed new automotive trim fabrics; T. W. Curry, Lynchburg Foundry Co., who told about nodular iron; and Secretary Joseph Gurski, Ford Motor Co. Panel member E. J. Hergenroether, who discoursed on substitute metals, left early for Washington and didn't get photographed

the tests are not complete but results are encouraging.

Nodular iron fills a particular need with its high strengths and good machining qualities. Its use would be widely expanded.

II. New Auto Trim Fabrics

In 1946 small amounts of nylon were used in bodycloth. Progress might have been slow but for skyrocketing prices of wool. By 1949, costs of sidewall and bodycloths had risen to a point that intense interest was expressed in a 100% synthetic material to replace cotton warp and wool filling sidewall cloth.

Experimental work led to the formulation of a 50% viscose—50% acetate material whose physical properties compared favorably with regular wool-cotton mixtures. It was used to a limited extent by one of the large manufacturers in 1949 models with satisfactory service records. Properties of the synthetic are shown in Table 1.

Synthetic bodycloth, consisting of 50% viscose, 35% acetate, 15% nylon, plus continuous filament yarn of 450 denier viscose for stripe effect, was first used in 1951 models. Service records to date indicate that this synthetic cloth has wide acceptance.

Each material used in this formulation performs a definite function. Viscose is used to provide the background color of the bodycloth while cellulose acetate adds softness and pliability. Nylon provides excellent resistance to wear and abrasion and is far better than wool, which is one of the poorest wearing fibers.

A very important characteristic of synthetic fibers is their ability to be selectively dyed with proper materials. This permits the manufacture of a minimum number of grey goods patterns that are subsequently piece dyed. Viscose staple picks up the largest amount of dye and is used to develop the darker colors. Synthetic staple fibers give the stylist a wide variety of combinations as they are made in bright, semi-bright and dull luster. Additional sheen is obtained by using continuous filament fibers on the face of the cloth.

There are available many other fibers, such as orlon, dacron, dynell, and chemstrand, which could be used in automotive textiles. However, they offer no particular advantages over the present viscose-acetate-nylon blends and are more expensive.

The use of synthetics will expand vigorously for these two reasons:

1. Synthetics can be expected to continue less expensive. The supply of synthetic fibers is continually expanding so that their price will be determined by free competition.
2. Better physical properties are consistently obtainable with synthetics.

III. New Synthetic Rubber

Many new and improved synthetic rubber materials have been developed for automotive use in the last few years. For a long time, the automotive industry was restricted to two basic materials: natural and reclaimed rubber. About 20 years ago, Thiokol and Neoprene rubbers made their appearance. Since that time progress has been rapid and possibilities of future progress are unlimited. The most widely used rubbers are the Buna S, Butyl, Polyacrylate, Silicone, Neoprene and Hypalon S2 types.

Buna S (GR-S) synthetic rubbers have numerous applications. Heat resistant types are supplanting natural rubbers in brake wheel cylinder cups or seals since they are more resistant to "set" and minimize leakage problems.

"Cold rubber" is GR-S made at low temperatures and is used largely in tires to improve service life. Its use is expanding to automotive mechanical goods such as engine mountings. There its better physical properties than those of standard GR-S and lower cost than natural rubber make its use desirable.

"Oil extended" GR-S is made by using low cost and readily available petroleum type oils to replace portions of the butadiene and styrene used as raw materials for GR-S. This reduces cost of regular GR-S 3 to 5¢ per pound without reducing the wear resistance of such parts as tires.

Low-temperature rubbers of the GR-S type are produced by increasing the butadiene-styrene ratios. Such materials give excellent low temperature service with adequate strength.

Butyl rubber is so outstanding in its resistance to diffusion of air that its use in tubes is unquestioned. Lately, its use in automotive hose, weatherstrips, shims, and boots is expanding because it is the lowest priced rubber.

Polyacrylate synthetic rubbers' most important automotive use is as a seal. In such applications, resistance to oils and heat are important factors since operating temperatures are continually increasing. Polyacrylate synthetics have heat resistance intermediate between neoprene and silicone rubbers, with some decrease in tensile strength, abrasion resistance, tear resistance, and compression set as compared to neoprene. They have outstanding resistance to extreme pressure lubricants, especially those containing active sulfur.

Silicone rubber, besides outstanding heat resistance, has unusual retention of flexibility at low temperatures. It is used in applications where its relatively poor strength and tear resistance can be compensated for by design.

Neoprene's (GN) resistance to oils, ozone, or weather and flexing are widely recognized. Types W, WRT and Q are modifications of GN in which improvements in resistance to compression set, to low temperatures and oil resistance are being sought.

Hypalon S2 is a newly developed rubber that has unusual resistance to ozone, oxygen and weathering. It is made without carbon black and can be furnished in almost any color.

IV. New Automotive Finishes

All decorative automotive parts, with the exception of stainless steel, need either a painted or plated coating to prevent corrosion and keep them decorative. The methods we have been using in recent years have been satisfactory, but industry is always striving for something better.

War modifies our ability to protect metals from corrosion with metallic coatings because the supply of metals used in these coatings, namely copper and nickel, become restricted. Governmental orders prohibit their use or permit only limited amounts to be used on items considered functional, such as bumpers, guards, handles, and channels. In general, industry is being asked to "retain the look without the means."

That industry has been reasonably successful is evidenced by the appearance of the cars being produced. This has been done in the following ways:

1. Increased copper, reduced nickel, regular chromium systems.
2. Increased copper, regular chromium systems with or without clear enamel coatings.
3. Copper, white brass, regular chromium systems with or without clear enamel coatings.
4. Zinc, bright dip, enamel systems.

Method 1 cannot be considered original, but its effectiveness is demonstrated by the fact that at least 50% of the nickel used on bumpers and guards has been saved. The reduction in nickel thickness has been partially offset by increasing copper thickness.

Method 2 is the most widely adopted procedure. Clear baked enamels are applied over coatings on parts used on the exterior of the car. Enamels may or may not be used on parts used in car interior, depending on the specific application. Preparation of such coatings require new methods of processing and present new problems. Life of properly prepared coatings should be satisfactory as long as the baked enamel film is not broken.

In the copper chromium sequence, color is obtained by buffing. This presents no problems such as adequate cleaning and cutting through copper on complicated shapes. Bright plating alone is not satisfactory. That's because defects are magnified when the final chromium plate is applied.

Electropolishing can be used instead of buffing in some cases, usually on small parts. It is difficult to get uniformity in large parts and in automatic equipment.

Method 3 is a new development. The white brass layer is an alloy of 20% copper and 80% zinc. It presents processing and brittle plate problems. Automotive applications of this coating are restricted to very small interior parts, such as molding screws, although it is used on large parts such as furniture and toys. Experimental work on this system is being actively pursued and may result in eliminating processing problems and increasing resistance to corrosion.

Method 4 is used only to a minor extent and then only in car interior applications.

Considerable amount of experimental work is continually being done on the commonly applied metals and on metals that are less commonly plated. Methods of deposition are continually being improved; however, while something may develop, there is nothing in the picture now that indicates any suitable substitute for nickel.

With all these materials shortages facing the industry, the question always arises about using other known finishes that use no critical materials. Let's take a look at a few. Ceramic finishes are limited in the size and complexity of parts to which they can be applied. And customer acceptance of such finishes is open to question. Sprayed metal coatings are too rough and do not lend themselves to buffing operations. Vacuum deposition has been used to deposit aluminum on plastics and as a reflecting surface for headlights. When used on plastics, a clear enamel has to be used over the aluminum deposit to preserve its appearance.

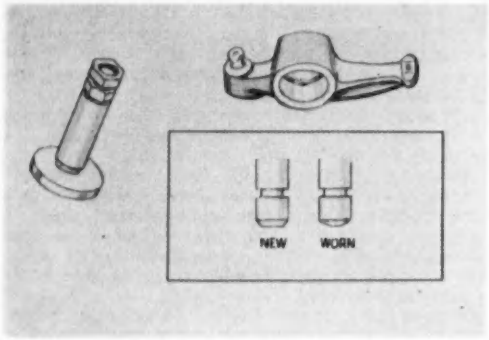
Table 1—How Properties of Wool-Cotton and Synthetic Bodycloths Compare

Property	Wool-Cotton	Synthetic
Tensile Strength		
Warp	50 lb minimum	200 lb minimum
Filling	45 lb minimum	100 lb minimum
Wyzenbeek Wear Test		
Warp	none-1 hr	none-5 hr
Filling	none-1 hr	none-5 hr
Fade	50 hr minimum	50 hr minimum
Water Spotting	None	None
Wet and Dry Crock	4.5*	4.5*

* 5.0 is excellent and 4.0 acceptable.

8 Ways to Get the Most Out of

Regrind worn rocker arms and tappets,



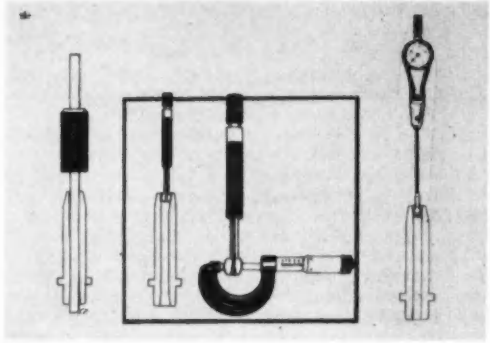
1--

The first step toward longer valve life is careful disassembly and inspection of parts. Good judgment and care are important in correcting or replacing worn, scaled, or otherwise damaged parts.

Two common wear points are the rocker arms and tappets. Wear first appears on the valve stem tip. The edges of the chamfer, which are normally sharp, will be round.

The corrective measure to be taken is to regrind the worn surface to make it conform to its original contour. In cases of extreme wear, replacement may be necessary.

. . . carefully measure guide wear, . . .

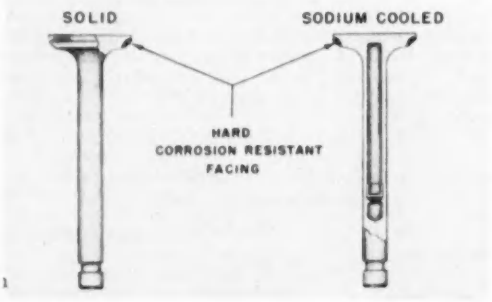


2--

The next item to be checked is the valve guide. Since guide wear is usually in the form of bell-mouth on the ends, or directional wear which makes an oval out of the inside diameter, it cannot be accurately measured with a plug gage. A more accurate device is the small hole gage.

Guide wear should be taken seriously because it affects overall valve temperature. As guide clearance increases, there is less contact between stem and guide . . . less heat conductivity . . . and greater temperature rise in both valve stem and head.

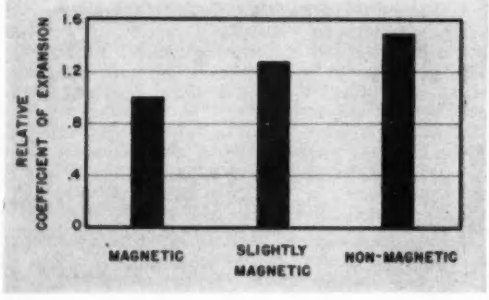
. . . sodium-cooled valves, and . . .



5--

The next important consideration is the selection of proper valves. Both solid and sodium-cooled valves are in common use. Sodium cooling normally reduces valve operating temperatures about 200 F. And whenever sodium-cooled valves are available, extended life gained through their use usually justifies their increased cost.

. . . account for various expansion rates



6--

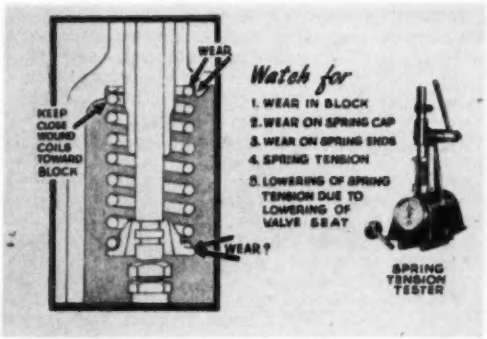
Premium valves are available for replacement purposes. These, in many cases, are made of different materials than the original valves. And coefficients of expansion may differ by as much as 50%. The change in length that will thus occur during valve heating under load must be accounted for by different lash settings.

VALVES

J. A. Newton and N. Hoertz,
Thompson Products, Inc.

Based on paper, "Considerations for Commercial Valve Maintenance," presented at SAE Annual Meeting, Detroit, Jan. 14, 1952.

. . . and check five spring wear points.


KEEP CLOSE WOUND COILS TOWARD BLOCK
WEAR
Watch for
1. WEAR IN BLOCK
2. WEAR ON SPRING CAP
3. WEAR ON SPRING ENDS
4. SPRING TENSION
5. LOWERING OF SPRING TENSION DUE TO LOWERING OF VALVE SEAT
WEAR?
SPRING TENSION TESTER

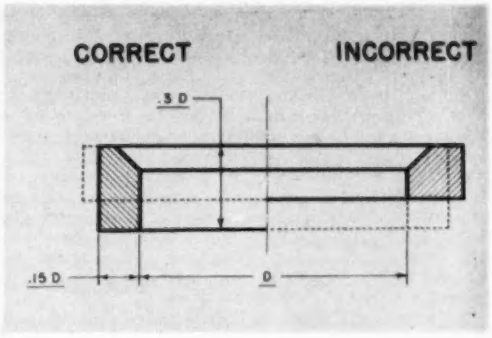
3—

Next comes the valve spring. There are five points to check:

1. Wear on the block.
2. Wear on the spring cap.
3. Wear on the spring ends.
4. Spring tension. Tension loss exceeding 10% of the specified required load indicates need for replacement.
5. Lowering of the valve on the seat—caused by grind-in.

When the valve seat is lowered 1/16 in. or more by valve grind-in, a new valve seat insert should be considered.

Use deep valve seat inserts, . . .



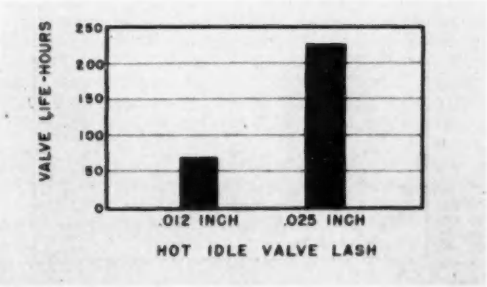
4—

If there's a choice between a deep and a shallow seat, the one with the greatest depth should always be chosen.

As for choosing between a hard iron seat and a hard-faced seat, two points must be weighed. A hard-faced seat has an endurance life of 4 to 5 times that of hard iron . . . but it costs more.

Having chosen the insert, it's important that the cavity in the cast iron block be machined smooth and square. Resulting maximum contact area means greater heat conductivity; hence, lower seat temperatures.

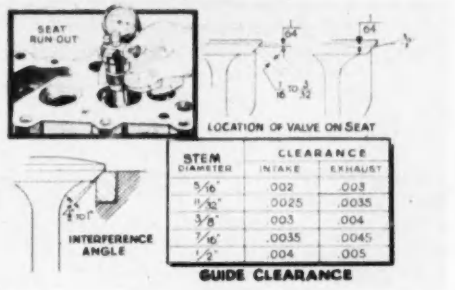
. . . with proper lash settings.



7—

The most important factor in good valve maintenance is correct lash. Insufficient operating clearances can reduce valve life to 25% of normal. Proper settings may not be responsible for desired valve life, but improper lash can be, and is, the cause of several undesirable conditions—the most important of which are burned and broken valves.

Then assemble all these parts carefully.



STEM DIAMETER	CLEARANCE INTAKE	CLEARANCE EXHAUST
5/16"	.002	.003
11/32"	.0025	.0035
3/8"	.003	.004
7/16"	.0035	.0045
1/2"	.004	.005

8—

Now the engine is ready for reassembly. The valve guide, after installation, is reamed to give nominal clearance. The valve seating surface is ground to a 0.002 in. maximum runout limit and is cut to the proper width of 1/16 to 3/32 in., allowing 1/64 in. overhang of the valve outside diameter. An interference angle is accepted practice.

Chemistry, Section Size, and Heat-Govern Properties of Ductile

PROPERTIES of ductile iron vary widely with chemical composition, section size, and heat-treatment. High levels of properties are obtainable in heavy sections as well as in light sections.

In the as-cast state, ductile iron containing 1.5 to 2.5% silicon has maximum tensile strength in all section sizes. Lower strengths occur at higher and lower silicon contents. Tensile strengths above 100,000 psi can be secured in 1- to 2-in. sections. In balancing chemical composition and section size for maximum strength as-cast, silicon is generally the best factor to juggle. Carbon exerts little effect on the strength or other properties. Phosphorus decreases the strength as-cast and should be minimized.

Strengths of 130,000 to 150,000 psi can be obtained by oil quenching or air cooling, then tempering at 1100 to 1200 F, or by transforming isothermally at 1100 to 1200 F. Sections that are fairly uniform oil-quench and water-quench without danger of cracking.

In annealed sections, tensile and yield strength vary directly with silicon content and section size.

Full annealing produces maximum elongation in ductile iron. Elongation in excess of 25% is obtainable in fully annealed sections up to 3 in. thick. As a rule, elongation decreases with both increasing silicon content and increasing section size. Controlled ductility may be secured by proper balance of silicon content and section size.

The base properties of ductile iron in ½-in. section and with 1.0% silicon are:

58,000 psi tensile strength
41,500 psi 0.2% offset yield strength
22.5% elongation
136 Bhn

Increasing silicon content produces changes in these properties:

Property	Approximate Change per 1% Increase in Silicon Content
Tensile strength	Increased 11,000 psi in ½-in. section, 10,000 psi in 6-in. section
Yield strength	Increased 12,000 psi in ½-in. section, 11,000 psi in 6-in. section
Elongation	Decreased 3% in ½-in. section and 5% in 6-in. section
Bhn	Increased 22-26 in ½-in. and 6-in. section

Section thickness exerts these effects on the mechanical properties:

Property	Change on Increase from ½- to 6-in. Section
Tensile strength	Decreased 6,000 psi at 1% Si, 12,000 psi at 4% Si
Yield strength	Decreased 3,000 psi at 1% Si, 12,000 psi at 4% Si
Elongation	Not changed at 1% Si, decreased from 14% to 7% at 4% Si
Bhn	Decreased 18 points at 1% Si, 6 points at 4% Si

The ratio of yield to tensile strength was changed appreciably by both silicon content and section thickness. The ratio of 0.75 generally used for ductile iron appears to be satisfactory for about 2-in. section thickness and 2.50% silicon. The ratio is increased with increasing silicon to as high as 0.827 for ½-in., 4% silicon castings, and decreased to as low as 0.635 for 6-in., 1% silicon castings.

The ratio of tensile strength to Bhn is apparently unchanged by silicon content above 2%. The ratio is about 450 for ½-in. sections and 410 for 6-in. sections. At 1% silicon content the ratio increased with section thickness from 430 in ½-in. section to 440 in 6-in. sections.

Straight-line relationships exist between both mechanical properties and silicon content and mechanical properties and section thickness. Therefore it seems reasonable that approximate formulas could be written for the calculation of certain mechanical properties of ductile iron if silicon content and section thickness are known. These calculations will hold only for fully annealed ferritic irons with spheroidal graphite structures and with 3.50% total carbon, 0.30-0.40% manganese, and 1.20-1.50% nickel.

A formula which can be used to calculate tensile strength with a fair degree of accuracy, at least for the averaged properties, is:

T.S. = 50,000 + 11,000(%Si) − 2,000(section thickness in inches)

A qualifying factor relating the effect of silicon content on section sensitivity could be applied to this formula, but it is of minor significance and would only make computation more complex.

Other formulas which can be applied with fair accuracy are:

Bhn = 110 + 25(%Si) − 2(section thickness in inches)

Elongation = 23 − 3(%Si-1) − 1.0(section thickness in inches)

Treatment Iron

D. J. Reese, International Nickel Co., Inc.
F. B. Rote, Albion Malleable Iron Co.
G. A. Conger, University of Michigan

Based on paper, "Effect of Chemistry and Section Size on the Properties of Ductile Iron," presented at SAE Annual Meeting, Detroit, Jan. 14, 1952. This paper appeared in full in the July 1952 SAE Quarterly Transactions.

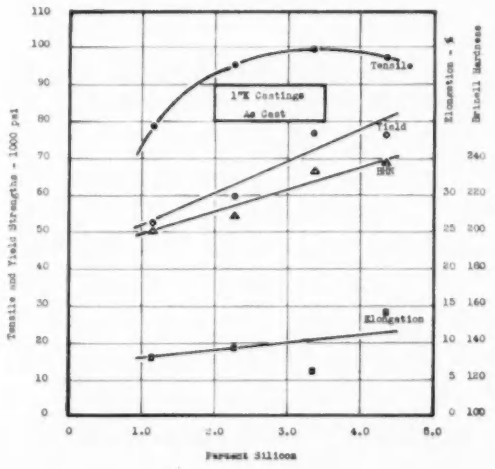
To investigate effects of variations in chemical composition, section size, and heat-treatment, series of melts and castings were made.

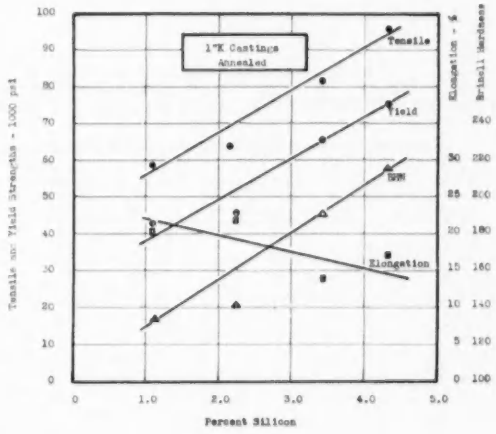
Charges for the melts consisted of pig iron, armco iron, ferrophosphorus, ferrosilicon, and ferromanganese. The pig iron and armco iron were charged and melted; then the ferromanganese, ferrophosphorus, and ferrosilicon were added. The charges for each furnace were proportioned to provide the desired nominal carbon and silicon contents. After all additions were made, the metal was superheated to 2800 to 2850 F and held there until the primary graphite dissolved completely. Then the melt was cooled to 2750 F and treated with a magnesium alloy.

Test castings included: ½-in. Y, ½-in. double keel, 1-in. Y, 1-in. double keel, 2-in. keel, 4½-in. keel, and 6-in. keel sections. They were cast in open baked-core molds and permitted to stand in the molds overnight before being removed. The castings were then cut up, heat-treated, machined, and tested.

Investigators prepared a complete set of tensile specimens from each section size of each heat in both the as-cast and fully annealed conditions. The full anneal consisted of (1) holding at 1650 F long enough to decompose the combined carbon, (2) furnace cooling to 1375 F and holding for complete pearlite breakdown, then (3) furnace cooling to room temperature.

Effect of Silicon on four melts of ductile iron containing nominally 1, 2, 3, and 4% silicon and 3.50% carbon



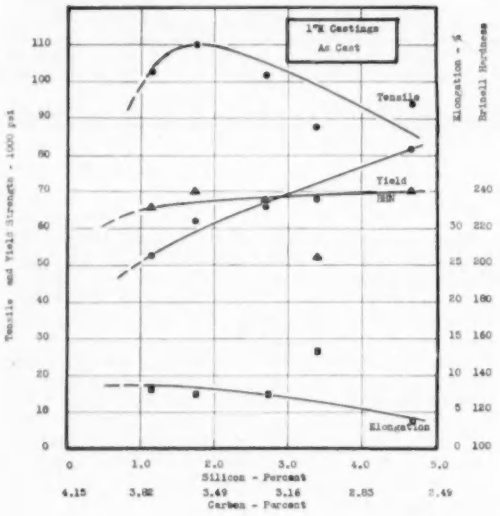


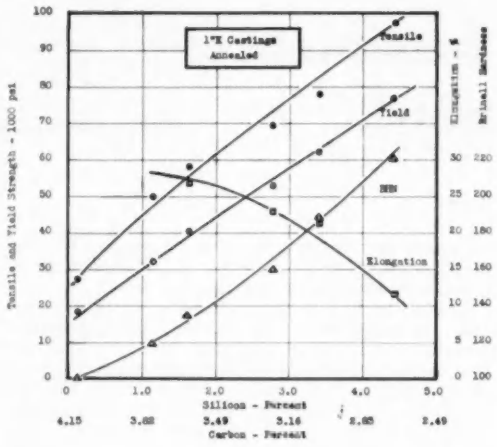
In the as-cast condition, increasing silicon content in a 1-in. keel section raised the tensile strength, yield strength, elongation, and hardness, but lowered the impact toughness.

A silicon content of 3.30% gave the maximum tensile strength, 100,000 psi. Yield strength for 3.30% silicon ran 73,000 psi, elongation was 10%, and hardness measured 230 Bhn.

As silicon content increased in the annealed 1-in. keel section, tensile strength increased from 55,000 to 90,000 psi, yield strength from 38,000 to 72,000 psi, and Brinell hardness from 130 to 215; but elongation decreased from 22 to 15%. The trends were the same in all section sizes in the annealed condition. The change in properties with increasing silicon content results from the silico-ferrite solid-solution hardening effect, which strengthens and embrittles the otherwise ductile ferrite.

Effect of **Carbon** on ductile irons having constant carbon equivalent of 4.15%

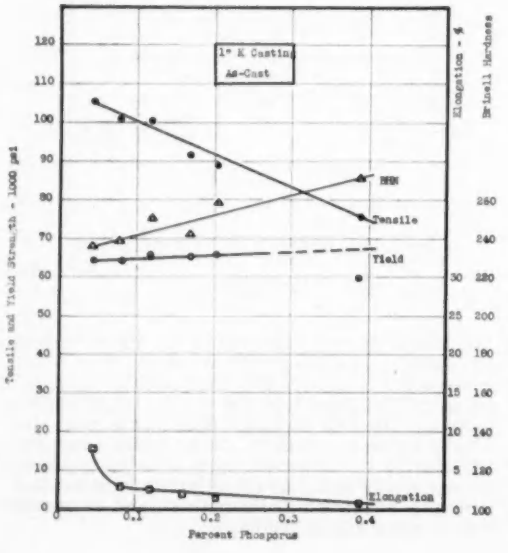




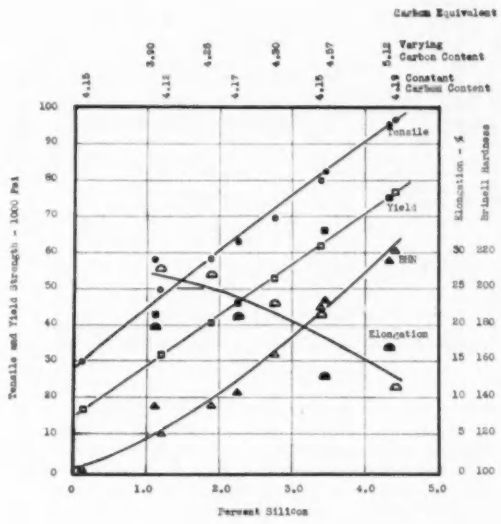
Carbon content has practically no effect on mechanical properties of ductile iron. This fact emerged from tests on a series of melts ranging from 2.75 to 4.1% carbon content and 1.0 to 4.7% silicon. All these melts had a carbon equivalent of 4.15%. The charts show the results of tests made on 1-in. keel sections in the as-cast and fully annealed conditions.

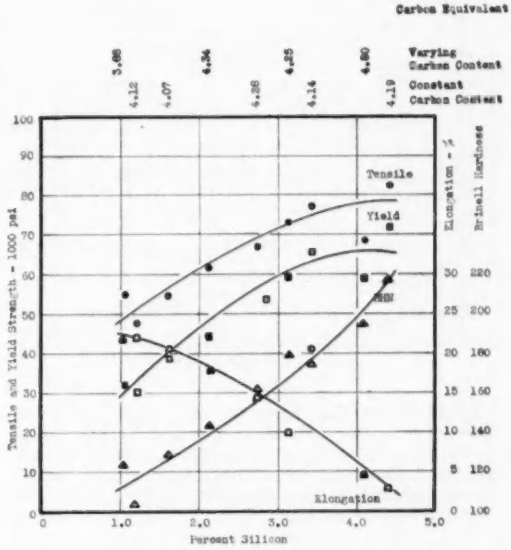
The data obtained from these melts at constant carbon equivalent were plotted with the data obtained from the melts having constant carbon content but variable carbon equivalent. The carbon equivalents, ranging from 3.88 to 5.12%, appear at

Effect of **Phosphorous** on six melts of ductile iron containing nominally 0.04, 0.08, 0.12, 0.16, 0.20, and 0.40% phosphorus and 3.45% total carbon, 1.80% silicon, and 0.35% manganese

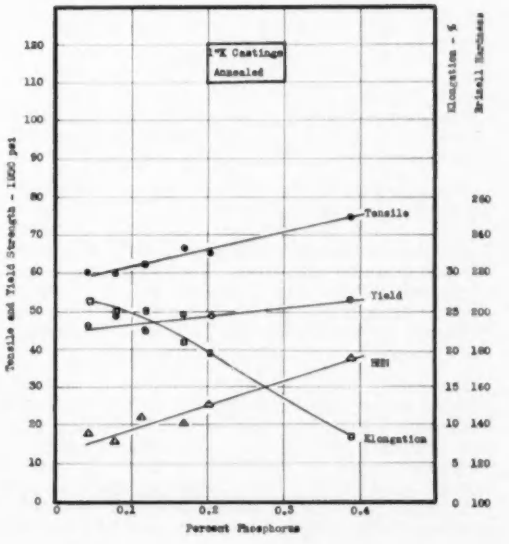


As phosphorus content increased from 0.04 to 0.40% in the as-cast 1-in. keel sections, tensile strength decreased from 105,000 to 75,000 psi, yield strength remained constant around 65,000 psi, Brinell hardness increased from 235 to 270, and elongation decreased from 8 to 1%. The elongation decreased most rapidly between 0.05 and 0.10% phosphorus. Similar results appeared in all sections from ½ to 6 in. These mechanical-property changes were due to solution of phosphorus in the ferrite in addition to the formation of increasing quantities of phosphide eutectic at the higher phosphorus levels.





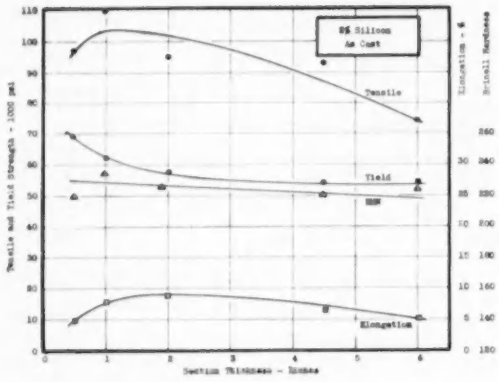
top of charts. (Left- and right-hand charts represent results for annealed 1-in. and 6-in. keel castings, respectively.) The open figures in these charts represent 4.15% carbon equivalent; the solid figures represent 3.50% nominal total carbon. The curves show that mechanical properties varied continuously with silicon content and without regard to carbon content.

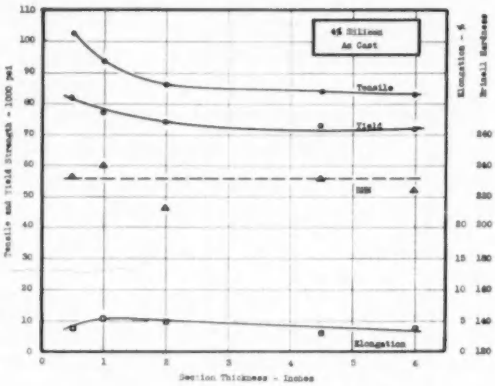


(Levels tested were 0.04, 0.08, 0.12, 0.16, 0.20, 0.40%.)

In annealed 1-in. keel sections, the effects of increasing phosphorus were much different. The soft, ductile, and relatively weak ferritic matrix was hardened, embrittled, and strengthened by increasing quantities of phosphorus in solution and the ultimate formation of phosphide eutectic. As the phosphorus increased from 0.04 to 0.40%, the tensile strength increased from 60,000 to 75,000 psi, yield strength increased from 45,000 to 53,000 psi, Brinell hardness increased from 130 to 175, and elongation decreased from 27 to 8%.

Effect of **Section Thickness** on ductile irons containing 2 and 4% silicon





In the as-cast 2%-silicon section, increasing thickness progressively lowered properties slightly, except in the range from ½ to 1 in. The ½-in. section contained a small amount of primary carbide which lowered the properties somewhat. Heavier sections were free of primary carbide. But with increasing thickness, the matrix structures contained larger proportions of ferrite and coarser spheroids which lowered the properties.

At 4% silicon, similar decreases in as-cast properties occurred with increasing section thickness. However, the ½-in. section was free of primary

Effect of **Heat-Treatment** on two melts of ductile iron containing 2.79 and 1.52% silicon

Heat-treatment influences mechanical properties of ductile iron considerably, studies of specimens heat-treated three different ways showed.

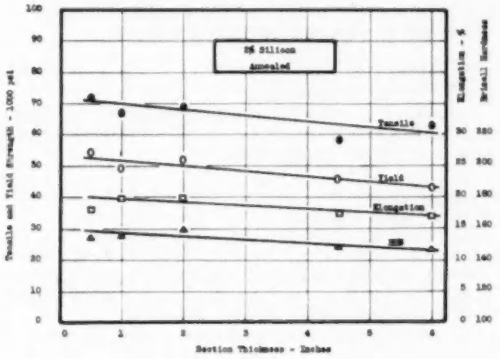
The first heat-treatment consisted of austenitizing for 2 hr at 1600 F, quenching in oil, and tempering 2 hr at 700, 800, 900, 1000, 1100, 1150, or 1200 F. Tempering at 1100 to 1200 F produced the best combination of usable properties. For 1.52%-silicon bars oil quenched from 1600 F and tempered at 1200 F, tensile strength was 110,000 psi, yield strength was 88,000 psi and elongation was 10%. Bars containing 2.79% silicon had slightly lower properties.

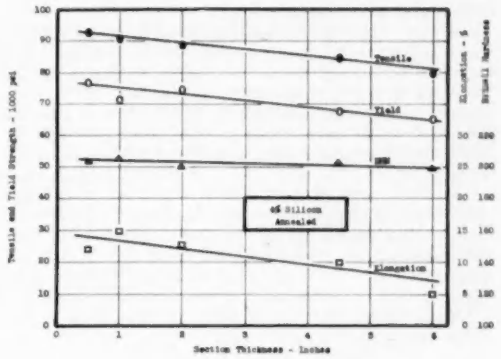
The second heat-treatment consisted of austenitizing 2 hr at 1600 F; quenching in salt or metal baths to 800, 900, 1000, 1150, or 1200 F; holding 1 hr, and then air cooling. The best combination of properties came in castings isothermally transformed at 1100 F. The treatment gave tensile strengths of 125,000 to 140,000 psi, yield strengths of 90,000 to 100,000 psi, and elongations of 7 to 10%.

Tests on quenched-and-tempered and on hot-quenched castings indicated the desirability of tempering or tranformation at 1100 to 1200 F to secure high ductility. Therefore, investigators reasoned, similar properties might be obtained in normalized-and-tempered castings. To check this reasoning, sections from keel castings were austenitized 2 hr at 1600 F; air cooled; and then tempered at 1100, 1150, and 1200 F. The tensile strengths of the normalized-and-tempered bars exceeded those of oil-quenched-and-tempered bars. Yield strengths were somewhat lower, and elongations were about the same. Bars normalized and tempered at 1200 F developed optimum properties.

(Paper on which this abridgment is based is available in full in multilithographed form from the SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

See page 54 for discussion

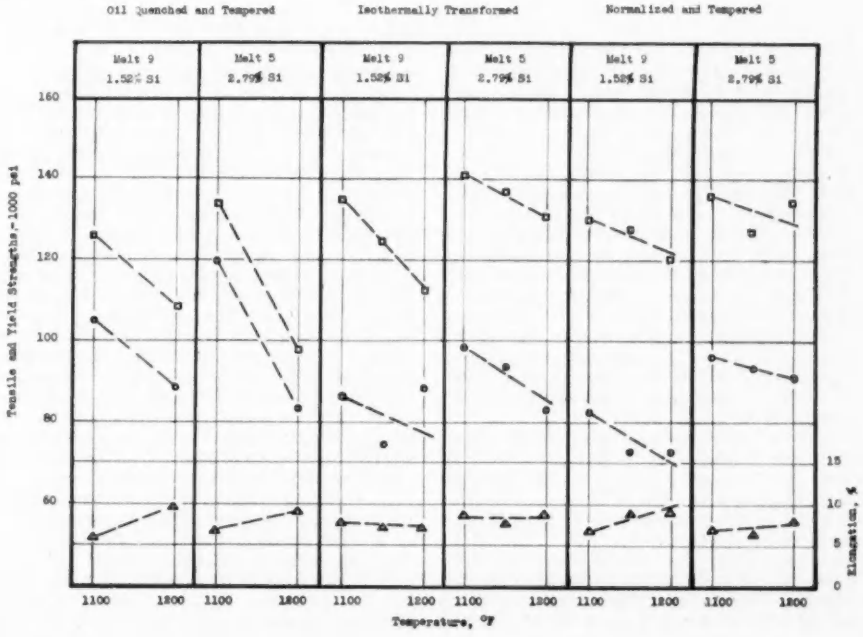




carbide and had the highest strength of the sections tested.

The charts for annealed sections of 2 and 4% silicon content show a uniform straight-line decrease in properties with increasing section thickness. The rate of this decrease is greater in the 4% than in the 2% silicon castings.

The degree to which the properties of the ductile iron castings dropped with increasing section is very small in comparison with other cast metals. Obviously section sensitivity is very slight for this material.



Oral Discussion

Question: Will these data have specific or practical application at this time?

Answer: The ASTM has established two grades of nodular iron; a high-strength grade called 80-60-03, meaning 80,000 psi tensile strength, 60,000 psi yield strength, and 3% elongation; and also a low-tensile high-ductility grade called 60-45-10. Requirements for these grades are given in the "Tentative Specifications for Nodular Iron Castings (ASTM Designation: A 339-51 T)."

The data presented by the authors on properties related to section size can be very useful. In applying the findings, however, engineers should remember that a large 1-in.-thick plate or a 1-in. square will not cool at the same rate as a 1-in. round. The area-to-volume relations influence cooling rates.

ASTM has a variety of sizes of test bars under consideration.

Question: What is a keel bar?

Answer: It is a kind of well-risered cast test specimen. The name comes from the "keel" of a boat. The cross-section of the specimen somewhat resembles the cross-section of a boat keel.

Question: How well do keel-bar results check with results on actual castings?

Answer: Other investigators have found that keel-bar results check reasonably well. We do not have any data on the correlation.

Question: What can be expected in sections smaller than 1 in.?

Answer: As sections decrease from 1 in. to ⅛ in., there is an increasing tendency in as-cast structures toward primary carbides. To avoid primary carbides, foundrymen must control the process rigidly and use suitable magnesium alloys.

If primary carbides are present, it is desirable to decompose them by heat-treatment. Otherwise mechanical properties and machinability will be impaired.

Facts and Fancy . . .

. . . make up piston ring lore. Engineering study on rings has unmasked old wives' tales cherished by many mechanics and technical men too.

BASED ON PAPER BY **A. M. Brenneke,** Perfect Circle Corp.

CURRENT use of piston rings evolved from practices dating back to the invention of the steam engine. Like any product originating in antiquity, rings have accumulated legend and superstition in the process of their evolution.

A great deal of mythology centers around the ring gap or joint, although in most engine applications there is probably no feature of design of less importance. End clearance leakage is important in most diesels since gap leakage is appreciable at cranking speeds when ease of starting is a consideration. In any ring joint construction, leakage is determined by the circumferential end clearance and the amount the ring overhangs the side of the ring groove, since the cavity back of the top ring operates practically at combustion chamber temperature. Leakage, therefore, is the same for butt, step and angle joint types.

The advent of new overhead valve engines may require that more serious thought be given to ring gaps. There is evidence that the top ring gap may spray the spark plug with oil if it happens to be adjacent to the plug when the engine is operating at high speed with closed throttle.

Whether or not rings turn on the piston is a subject of frequent debate. In all our experience we have found that they do turn. Examination of wear marks on the side surfaces usually convinces the doubters. The most plausible explanation is that rotation is a function of alignment of the various reciprocating and rotating parts of the engine and the crankshaft vibration characteristics.

Almost all mechanics have a special ritual for arranging the ring gaps when they assemble an engine. While the top and second ring gaps do appear to have a tendency to be either within 15 deg of each other, or 180 deg apart, the incidence of top and second ring gaps being aligned at time of disassembly is hardly alarming. Satisfactory performance of engines which have the rings pinned with gaps aligned makes the matter inconsequential.

There are many popular beliefs regarding the contours of edges and corners of compression and oil rings, particularly the latter. Chrome plating has done much to dispel the mystery of corner contours and the belief that edges and corners must be square and sharp. It was necessary to round or chamfer corners to prevent treeing of corners in the chrome plating process, and research has disclosed no harmful effect on either sealing ability or oil control. (Paper, "A Brief History of Piston Rings as of 1952," was presented at SAE Mohawk-Hudson Section, Schenectady, March 12, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers).

West Coast Meeting Details Outlook For Commercial Vehicles

J. C. Ellis, Shell Oil Co., Field Editor

WHAT'S ahead for commercial vehicles? A diversified group of 322 engineers found this a ripe subject for discussion at the 1952 SAE National West Coast Meeting, San Francisco, Aug. 11-13. Tomorrow's requirements from the standpoint of the fleet operator, fuels and lubricants supplier, and design engineer were set forth at six technical sessions and actively discussed by audiences ranging in size from 150 to over 200.

This theme was also highlighted at the banquet session where J. Roger Deas, American Can's Public Information Service Manager, stated that the nation's automotive engineers have made it possible for America to eat better through development of better farm equipment . . . and their progress in the past points the way to a brighter future.

Fleet operators in attendance at T & M-sponsored sessions were told that chassis dynamometers would enable them to convert horsepower into ton-miles more efficiently. They were reminded that in the competitive field of transporting material or people, maintenance efficiency must be high and costs low. Pointed out also was the fact that bearings are an integral and vital part of transmissions and must be treated with as much respect as the gears. Finally, requirements of tomorrow's intercity common-carriers were stated to be increased cubic foot carrying capacity and lighter weight vehicles.

SAE'ers and guests at F & L sessions learned all about the Humphreys constant-compression engine. Not only was it described in latest detail, but the constant-compression units installed on an Oldsmobile 76 engine were on display . . . as was an integrally-cast head soon to be used.

What's more, the need for a better oil filter or cleaner less-contaminant-producing fuels for tomorrow's engines was expressed. Described, too, were the new API service classifications for lubricating oils and results of field trials with oils tailored to meet specific service requirements. The status of grease in automotive lubrication was reviewed in the light of desirable future trends in this particular field . . . and further simplification forecasted.

The use of engine horsepower to steer vehicles which cannot be handled manually was a topic of interest at a T & B session. Operators also were told that liquefied petroleum gas offers many attractions as a fuel for truck and bus applications.

The influence of fuel in the development of power plants must be recognized if future design trends are to be realized, a speaker at a Diesel session pointed out. This consideration must be kept in mind if attention is to be focused on the developments which may be expected to appear in the next five or more years. Demands for higher horsepower outputs per cubic inch of piston displacement and higher horsepower per unit of space make the gas turbine attractive, this engineer said.

The drawbacks of present-day air filters—and possible ways to eliminate some of them—drew comment at another session.

Cut Maintenance Costs

E. L. Cline, of Clayton Mfg. Co., was the engineer who discussed the role of chassis dynamometers in keeping maintenance costs down. Look at it any

He Welcomed SAE'ers and Guests

General Chairman W. G. Nostrand extended greetings to everyone on behalf of the Northern California Section

way you want, said Cline, a fleet operator is in the business of selling ton-miles, and the price he pays to develop horsepower to deliver this end product is all-important. Hence, it's up to fleet maintenance departments to generate adequate and reliable horsepower efficiently . . . and a chassis dynamometer will help them do it, according to this engineer.

A chassis dynamometer has three primary functions in any fleet maintenance department: (1) exacting diagnosis, (2) thorough after-repair checking, and (3) correct final adjustments. To take full advantage of a dynamometer's potential, shop personnel must be adequately trained, satisfactory performance standards established, and the unit kept busy and properly located. If these steps are taken, Cline asserted, the chassis dynamometer will greatly aid the maintenance shop in fulfilling its responsibility of finding out what is wrong, repairing it, then proving the repair has been correctly made.

International Harvester's F. B. Lautzenhiser suggested that an accelerometer might be used to obtain the same benefits as a dynamometer. Cline agreed an accelerometer might take the place of a dynamometer for spot checks, but no road instrument could have the flexibility or offer the service possibilities or potentials of a chassis dynamometer, he contended.

Discussor I. M. Harlow, Sr., of Tidewater Associated Oil Co., wanted to know whether excessive tire wear would result from using chassis dynamometers as service tools. Cline explained that ordinarily equipment is not on a dynamometer long enough to cause excessive tire overheating and wear. Fans can be used to cool the tires if necessary, he added.

Using the latest types of maintenance tools and shop equipment is one way operators can keep costs down, another engineer agreed. But success of future maintenance programs, said Los Angeles-Seattle Motor Express' D. H. Mikkelson, also hinges on:

1. Sufficiently large, properly laid out, warm, clean, well-lighted, and well-ventilated working areas.

2. Stockrooms so equipped that 95% of the time they'll have the parts needed.

3. Cooperative drivers whose reports of trouble are given prompt and careful attention.

4. Good supervisors and employees who know when and what to do to each vehicle.

5. Using the advice of representatives of the various supply and service organizations.

Periodic meetings of all maintenance and allied personnel help, too, added discussor C. H. Lewis, of Standard Oil Co. of California.

At another session, W. H. Paul, Oregon State College, and I. B. Humphreys, Humphreys Investment Co. disclosed latest developments with the Humphreys constant-compression engine.

(Humphreys-Paul presented this paper at the 1951 SAE National Fuels and Lubricants Meeting. It appeared in full, together with considerable discussion, in SAE Quarterly Transactions, April, 1952, pp. 259-273.)

A better oil filter would be a boon to engine life, Ford's R. J. Pocock told one gathering. Present-day full-flow filters are still far from perfect . . . but give them enough space and oil pressure and they'll do until tomorrow's "dream" filter or cleaner fuels come along.

More Power Steering

More truck drivers of tomorrow are going to get a welcome assist from power steering, predicted Vickers' W. F. Driver. Drivers of off-highway equipment and passenger cars have it . . . so why not the man behind the wheels of on-highway commercial vehicles, he asked.

Power steering on these vehicles might pay off in more ways than the obvious one, according to Driver.

Present-day front-end designs are largely governed and restricted by the limitations of manual steering, he asserted. Would it be possible with power steering to change the traditional 1/3 on front, 2/3 on back weight-distribution-concept? Would it become practical to load the front axle up to the legal limit of 18,000 lb thus getting four or more tons of payload on each trip?

Methods of spring suspension and shackling on front axles are sometimes governed by the effect they will have on stability of the manual steering system, Driver went on to say. Can power steering open the door to revised thinking on this subject?

The future of liquefied petroleum gas as a fuel for internal combustion engines was projected by Hall-Scott's J. E. Glidewell, who stated that LPG was a "vitamin-enriched" fuel which offered increased power output, greater economy, and lower maintenance.

Improvement of fuel quality and uniformity, he said, is helping to hasten acceptance on a wider scale. What's more, greater stability in the supply—hence the price—of all LPG fuels augurs well for increased use in commercial vehicles, according to Glidewell. In the past, seasonal price variations worked a hardship on fleet operators. Recently, however, increased use in farm equipment has offset to a great extent the extensive winter demand for heating purposes.

In reply to a question asked about price and availability of LPG, Glidewell said that present production is some 10 million gallons per year but that estimated future potential is between 30-40 billion gallons per year. Price, he added, is determined by geographical locations and quantity purchased. Large users can buy directly at the main supply points, whereas the small consumer must deal through a distributor and pay the additional cost of handling.

Tips on Transmission Bearing Maintenance

To get the most out of transmission bearings, fleet operators of heavy-duty hauling vehicles have but to follow a few simple rules, said Spicer's E. J. Barth and Fuller Mfg.'s T. Backus.

1. Use only bearings recommended by the transmission manufacturer as replacements. Don't be fooled by apparent similarity in design of bearings in different makes of transmissions.

2. Don't discard perfectly good bearings simply

They Engineered . . .

Committee Chairmen who molded this highly successful meeting were: W. G. Nostrand—General Chairman; R. W. Goodale—Program; E. J. McLaughlin—Arrangements; E. B. Lien—Banquet; R. E. Jeffrey—Finance; T. S. White—House; N. Buchanan—Registration and Reception; J. V. DeCamp—Publicity; S. Onorato—Sight-seeing and Transportation; and J. C. Ellis—Field Editor

. . . Directed . . .

Session Chairmen who so ably presided over the six technical sessions were: H. E. Lovejoy—Monday morning; E. B. Ogden—Monday afternoon; S. W. Stephens—Tuesday morning; B. Trout—Tuesday afternoon; E. N. Klemgard—Wednesday morning; and B. T. Anderson—Wednesday afternoon

. . . and Recorded Meeting

Session Secretaries who did a great job of reporting discussion were: B. E. Boswell—Monday morning; R. A. Coit—Monday afternoon; P. L. Pinotti—Tuesday morning; J. V. DeCamp—Tuesday afternoon; H. M. Hirvo—Wednesday morning; P. I. Brown—Wednesday afternoon

He Explained . . .

W. H. Paul described latest developments with the Humphreys constant-compression engine . . .

They Listened . . .

. . . to a packed house of fleet operators, engine designers, and fuels and lubricants suppliers, who found out—among other things—that a "stubby" constant-compression unit has been developed . . .

Then Looked

. . . then Fred Agabashian, Floyd Leopold, and A. Black took time out to look at what they heard about.

They Sat at the Speakers Table

Seated at the speaker's table listening to Toastmaster J. W. Sinclair introduce the principal speaker of the evening were (left to right): E. W. Rentz, Jr., SAE Western Branch Office Manager; SAE Councilor and Program Chairman R. W. Goodale; Principal Speaker J. Roger Deas; Sinclair; Northern California Section Vice-Chairman J. E. Glidewell (hidden by rostrum); SAE President D. P. Barnard; General Chairman W. G. Nostrand; and SAE Secretary and General Manager John A. C. Warner

because dirt has gotten into them. Clean them!

3. Don't put new bearings in a questionable transmission housing. A case mutilated to the extent that faces need refinishing—and holes reboring and resleeving for proper bearing fit—is a poor risk.

4. Always maintain cleanliness by draining, flushing, and refilling with clean lubricant periodically.

5. Use only the proper lubricant.

To clear up a few fine points, discussors fired these questions at Barth-Backus . . . and received these answers:

Q.—What do you recommend with regard to flushing and refilling of truck transmissions? A.—This depends entirely on the application. Fuller recommends draining, flushing, and refilling at 10,000 miles; Spicer at 12,000 to 15,000 miles. Transmissions should be drained, flushed, and refilled after the first few thousand miles of operation to remove metal particles which may be picked up by the oil when the transmissions are first put into service.

Q.—Frequent drains are recommended to eliminate dust and dirt. This indicates the possibility of moisture accumulation. Don't you think compounded oils would be better to eliminate possible corrosion? A.—No. Straight mineral oils are adequate for the gear tooth loads in transmissions, and this is the basis for our recommendation.

Q.—What method is recommended for flushing transmissions? A.—Transmissions should be flushed when hot, at which time the oil is thin and will drain thoroughly. The main objective is to remove dirt and metal particles. If examination of the oil indicates possibility of dirt remaining, some type of solvent should be used to finish the job.

Q.—What is being done to improve lubrication of the flywheel pocket bearing? This bearing can't be lubricated once it is installed. A.—Some work is being done on redesign of the bearing itself. The only way to get around this lubrication problem is to use prelubricated sealed-for-life bearings.

Carry More . . . Weigh Less

Future intercity common-carrier truck-trailer units are going to take on a new look if today's needs become tomorrow's deeds, observed Associated Transport's W. P. Davis. What the industry needs, according to this operator, is a three-axle unit that doesn't weigh over 12,000 lb, which has adequate gradeability with loads up to 60,000 lb. In short, Davis stated, tomorrow's common-carriers should be lighter in weight . . . and have greater cubic foot carrying capacity, too.

The importance of these needs was stressed by Timken-Detroit Axle's E. W. Templin. He pointed out that Valley Lines in California had calculated that on a 14-ton haul from San Francisco to Los Angeles only 1000 lb on the van represented profit

after expenses were taken out. Thus, if tomorrow's "dream vehicle-combinations" can be achieved, said Templin, an additional 1000 lb payload could be carried . . . and profits doubled.

Pack More Power

Caterpillar's C. G. A. Rosen envisioned heftier powerplants for commercial vehicles. The day is not too far off when 1000 to 1200 hp engines will be needed for some earthmoving operations, he said. What's more, one of the best ways to reduce costs is to move loads faster, contractors and operators agree, and this means just one thing—more horsepower.

This puts it squarely up to equipment manufacturers, Rosen stated. Should the prime mover be a gas turbine, high-speed aircooled diesel engine, supercharged 4-cycle diesel, loop-scavenged 2-cycle diesel, high compression ratio spark-ignition engine or a compound engine? Which can pack the necessary "horses" with the least weight, space, and fuel-consumption penalty?

A gas turbine, for example, packs lots of power in a small space at low power/weight ratios. But fuel economy so far is much poorer—and first cost much higher—than diesel engines, Rosen pointed out.

Four-cycle supercharged diesel engines, too, offer a real opportunity to achieve higher outputs in alotted space, according to this Caterpillar consultant. But here, surprisingly enough, the principal drawback is the supercharging units. Under present conditions, they're either unable or too inefficient to match vehicle performance requirements. Turbosuperchargers and centrifugal blowers have not yet been fully explored, though, and do offer great promise, Rosen added.

Other roads to higher outputs, concluded this engineer, are:

1. Continued improvement of materials and lubricants.

2. Equalization of heat transfer through the main combustion chamber envelope to relieve cylinder head and piston structures of undue mechanical and thermal stresses.

3. Control of the flame front of the gas injected (or otherwise introduced combustible) to prevent destructive concentration of heat flow through metals.

All air filters today have some drawbacks, Air-Maze's R. E. Brown told engineers at another session. Either they take up too much space, cost too much, have relatively poor dirt-removing efficiency or too much pressure drop as dirt build-up occurs.

But tomorrow may be a different story, he added. An air filter that removes all dirt, stays clean, occupies no space, weighs nothing, and costs nothing won't pop up . . . but some of these unexplored possibilities may lead to a better filter: (1) self-charging electrostatic plastics with automatic washing, (2) high-efficiency centrifuging with ex-

Packed Houses Keenly Enjoyed These Remarks By . . .

D. P. Barnard

SAE President

Slightly over 25 years ago, a young man named Lindbergh flew solo across the Atlantic. Shortly afterward, Boss Kettering is reputed to have made this legendary comment: "Yes, it's marvelous that he did it alone, but it would have been miraculous if he had done it with a committee."

The growth of organizations is most interesting and worthy of study. With certain notable exceptions, such growths are dictated by rising needs and are measures of progress . . . So it is with SAE.

Some of the most worth-while contributions made by members of SAE—and some of the most effective services the SAE has been able to render to its members—have evolved at Section, Activity, and committee meetings. It is no wonder, then, that SAE West Coast Meetings are so successful.

John A. C. Warner

SAE Secretary and General Manager

Folks have been drawn to Northern California for more than 100 years in their search for gold of one sort or another. Some have dug for the yellow metal . . . others have sought and found a more valuable and durable gold in the form of information, ideas, guidance, inspiration, enjoyment, and friendship.

The boys who dug their gold from holes in the ground have met a tragic fate. After endless toil—some even gave their lives—they accumulated tons of the precious metal . . . Then somebody came along—took all the stuff away from the boys—dug another big hole and put the gold right back in the ground at Fort Knox.

. . . It's a different story with the kind of gold we've been getting right along in SAE. Ours is the stuff that can't be buried at Fort Knox or anywhere else. It becomes effective in better vehicles, better equipment, better practices, and greater zest for living all along the way into the future.

It's "B. C." in '53 . . .

In 1953, the SAE National West Coast Meeting will be held for the first time in Canada. Site will be Vancouver, B. C., with the SAE British Columbia Section as host.

ternal energy sources, and (3) ultra-sonic agglomeration of particles.

Custom-Tailored Oils

Tailoring a lubrication oil to fit service requirements really pays off in increased engine life, noted J. A. Miller, California Research Corp., and B. M. Berry, Standard Oil Co. of California.

Miller-Berry paused to explain the new API service classification for lubricating oils, then went on to tell how field tests showed that custom-tailored oils could hike engine life.

The system is a completely new approach, they said. It's based on operating conditions, engine design, and fuel type rather than oil characteristics . . . and defines five types of service—three for gasoline and two for diesel engines.

Field tests on a fleet of taxicabs showed that effective engine life could be doubled by using an oil tailored for this type of service rather than one designed for less severe service, Miller-Berry pointed out.

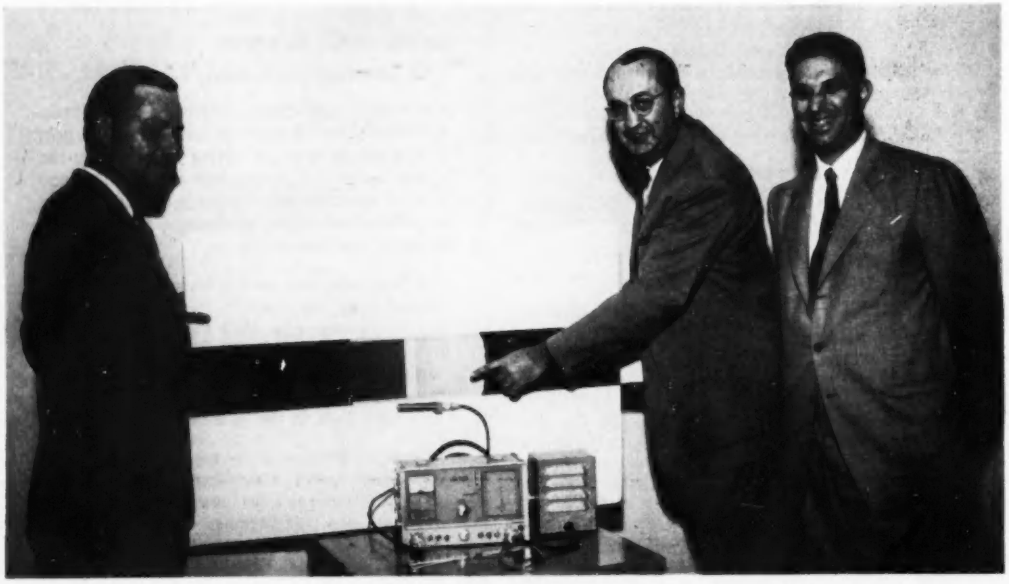
Gulf's W. A. Howe wanted to know whether the survey was limited to cars operated by original owners. Miller-Berry told him that it was not. They explained that it was impossible to establish the ownership history of all the cars included in the survey. Information available did indicate, however, that ownership varied from the original owner to a third party.

In another area, Union Oil's L. W. McLennan and E. Amott looked to even simpler grease lubricating of future commercial vehicles.

Already the trend is toward use of not more than two "conventional" greases or use of a single multipurpose grease, according to these engineers. Ultimately only multipurpose greases will be used for lubricating automotive equipment, they predicted.

And that's not all, continued McLennan-Amott. The continued trend toward use of rubber on chassis points is going to reduce the number of lubrication points, too.

They Told Televiewers About Meeting



General Chairman W. G. Nostrand, Program Chairman Wayne Goodale, and Don Hull (right to left) publicized the meeting by telling the television audience of station KGO-TV in San Francisco how radioactivity is used in automotive engineering research

How Chrysler Pictures Engine Harshness

L. M. Ball, Chrysler Corp.

Based on paper, "Passenger-Car Noise—Engine Harshness" presented at SAE National Passenger-Car, Body, and Materials Meeting, Detroit, March 6, 1952.

A DISTINCTLY unpleasant, unmechanical noise may issue from automobile engines operated at light throttle and moderate speed. Chrysler calls this noise "engine harshness." But it has been known as combustion roughness, crank rattle, and by many other names . . . and has been ascribed to a great variety of causes.

Chrysler decided some time ago to investigate this engine-harshness riddle and found that:

- Engine harshness involves bending vibrations of the crankshaft.

- The amount of harshness is affected by the nature of combustion.

- The crank system amplifies tremendously the frequency components of the cylinder pressure wave that produce harshness.

How were these conclusions reached?

First step was to make a tape recording of the sound produced by a typical engine running at moderate speed and about half throttle. When this recording was played back (assuming there was engine harshness), a metallic, rattling type of noise was easily distinguished through the background of general noise.

Next, this sound was emphasized to get a rough idea of the characteristic frequencies involved. This was done by inserting a filter in the electrical circuit which excluded everything except those sounds in a particular frequency band.

Fig. 1 shows a frequency scale and several bands of frequencies that can be selected by a band pass filter. To determine which band contained most of the engine harshness, the three were listened to in turn—each time comparing the sound in the band with the whole sound.

Like Slow Drum Beats

The objectionable components of the harshness were found to lie almost entirely in the 300 to 600

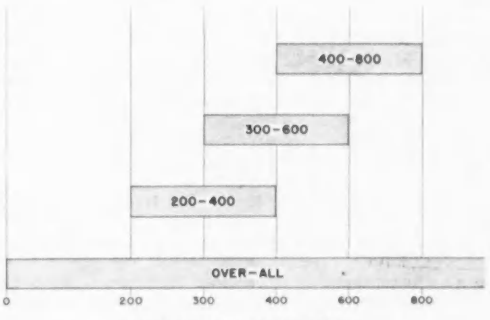


Fig. 1—The objectionable components of engine harshness were found to lie mostly in the 300 to 600 cps frequency band

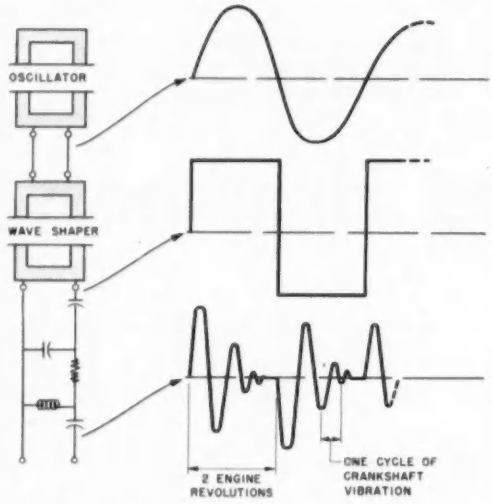


Fig. 2—Certain important characteristics of engine harshness could be identified with this simple type of synthetic wave form

cps band. They sounded like drum beats and were so slow they could almost be counted.

This point has been the subject of a great deal of investigation. The conclusion drawn is that the so-called drum beat of this sound is emitted every time the crankshaft makes two revolutions or every time a certain cylinder fires. In other words, the repetition rate is one-half order.

This conclusion suggested that it might be possible to produce a synthetic sound, characteristic of this harshness. For a first approximation, the circuit shown in Fig. 2 was employed. The oscillator was adjusted to produce a signal with a basic frequency of one-quarter order. The signal was shaped in a simple circuit, then applied to a resonant circuit tuned to a frequency in the 300 to 600 cps band. The resulting signal was a moderately damped wave, having a frequency of about 400 cps and a repetition rate of approximately one-half order at 1200 rpm—that is, 10 times per second.

When this synthetic harshness was compared to the real thing, it was found the synthetic harshness did not sound exactly the same as the harshness produced by the engine. However, certain important characteristics of engine harshness could be identified with this simple type of synthetic wave form.

The wave form was suggestive of a system vibrating at its natural frequency under the influence of repetitive, impulsive excitations, or, in plain English, it suggested something vibrating between hammer blows. To duplicate this sort of thing, the setup shown in Fig. 3 was tried. The heavy weight was arranged to bang into the crankshaft counterweight, thus setting the crankshaft into vibration. The pattern of vibration picked up and recorded was a great deal like the synthetic wave form, and the frequency was in the 300 to 600 cps band.

Scheme Terrifies Bearing Experts

On this setup, various resilient backing layers for the main bearings were tested in the hope that crankshaft vibration could be isolated from the block, thus reducing the amount of noise radiated. While we were quite successful in attaining this objective, the thickness and softness of the backing necessary to produce effective vibration isolation terrified the bearing experts—so the whole idea was abandoned.

It seemed that it would be better to induce the vibration in a more natural way. This was done by locking the flywheel so the crankshaft could not turn, filling one of the cylinders with oil, and sending impulses of pressure into this oil by means of a diesel fuel-injection pump. The hydraulic system was easily adjusted so that the pressure wave in a cylinder looked very much like a typical engine indicator card.

This was a good setup. Any cylinder could be pulsated at any crank angle, and the crank could be plastered with vibration pickups since it was not rotating. Tests of this kind confirmed previous data on the frequency and wave form of crankshaft vibration and, in addition, indicated the relative

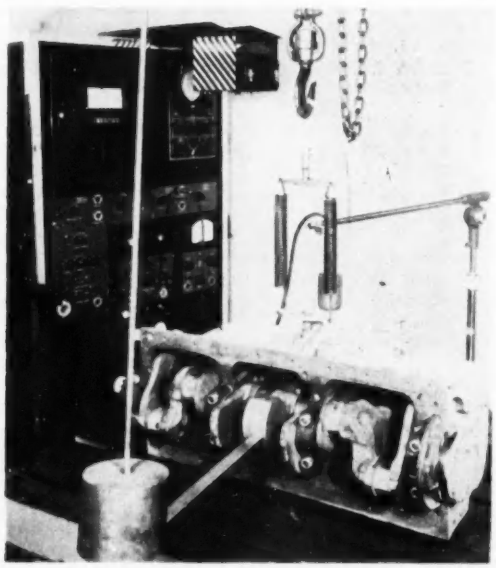


Fig. 3—When a heavy weight was arranged to bang into the crankshaft, the resulting pattern of vibration was much like the synthetic wave form

importance of the various cylinders in exciting such vibrations.

The pattern of crankshaft bending deflection was determined for various excitations. A typical case is shown in Fig. 4, although the deflections are overexaggerated for illustrative purposes.

Delve into Forces Exciting Harshness

Since the amount of vibration produced depends not only upon the properties of the vibrating system but also upon the nature of the exciting forces, attention was naturally directed to the combustion phenomena. This was a very extensive program which finally centered on the shape of the combustion space. Instead of going through all the ramifications, let's discuss the final results.

Fig. 5 compares the original cylinder-head contour with the "power flow" contour, shown by the dotted line. Sound recordings made at strictly comparable speed, load, and spark advance showed a marked reduction in noise with the power-flow cylinder head. This was due entirely to altered combustion resulting from the change in cylinder-head contour.

During the course of working out this cylinder head, variations in spark advance were evaluated. It was found that the harshness could always be eliminated by a sufficiently large reduction in spark advance. It was further determined that so long as the engine was not detonating, increasing the antiknock rating of the fuel had little or no effect on harshness.

This gave us an opportunity to compare the effect which spark advance has on power and the effect it has on engine harshness. Two conditions, A and B, were compared. "A" was the condition with normal spark advance and normal power (100% power), while "B" was the condition with maximum power spark advance and 15% more power.

Sound recordings of these conditions showed that if we tried to take advantage of the 15% gain in power, the penalty would be a 50% increase in engine harshness. Since advancing the spark increases harshness about three times as much as it increases horsepower, it might be reasoned that a net improvement could be made by reducing the spark advance somewhat below what we have called normal or commercial. This would reduce the power a little . . . and the harshness a lot. We were not surprised to learn that this line of reasoning did not appeal to the engine people at all!

Another very fundamental factor in combustion is the compression ratio of the engine. To evaluate its influence on harshness, the noise obtained with the standard compression ratio was compared to that obtained with a high compression ratio. However, to make the conditions comparable, the spark advance with the higher compression ratio was reduced to give the same power in both cases.

Sound recordings of these conditions showed very definitely that increased compression ratio with reduced spark advance substantially reduces harshness with no loss in power.

Next it seemed logical to expect that disturbing, exciting frequencies would be present in the explosion pressure wave of an engine producing a great deal of harshness. Thus, it was felt that—if a means could be found to listen to them—the explosions would be found to have the sharp, staccato quality, characteristic of harshness.

By a little deliberate intermingling of experimental techniques, such a means was devised. Instead of running the pressure pickup in the cylinder head to an oscillograph, it was hooked up to the imput of a magnetic tape recorder.

Then came the surprise! The explosions sounded smooth, powerful, and well-behaved . . . and not at all like the harsh, staccato sound of engine harshness.

Where, then, does the harshness come from? There seems to be only one plausible explanation. The crank system by resonant amplification accentuates tremendously those frequency components of the cylinder pressure wave which produce harshness. Thus, in addition to the factors which alter the combustion process, modification of the dynamic properties of the vibrating system also can have an important effect on the amount of harshness produced.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

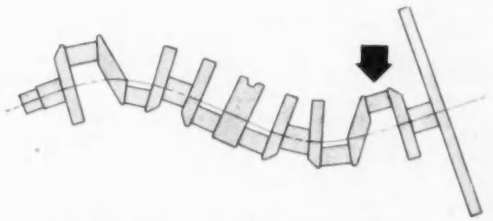


Fig. 4—Grossly exaggerated bending pattern of crankshaft

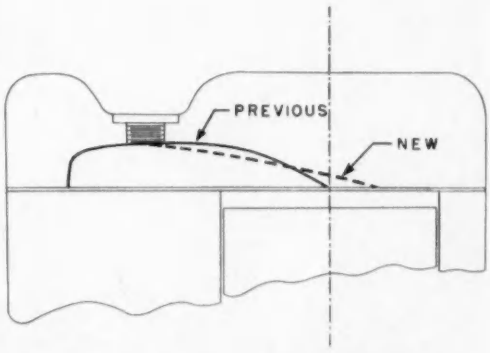


Fig. —Changing the shape of the cylinder heads brought about a marked reduction in engine harshness

SAE Honors Engineering

Kettering and Barnard Keynote Speakers At SAE Centennial of Engineering Banquet

THE SAE Banquet at the Centennial of Engineering in Chicago on Sept. 4 registered SAE's tribute to the general progress made in engineering since the American Society of Civil Engineers was founded in 1852. Presentation by SAE to the ASCE of a plaque commemorating ASCE's 100th Anniversary was a feature of the banquet program.

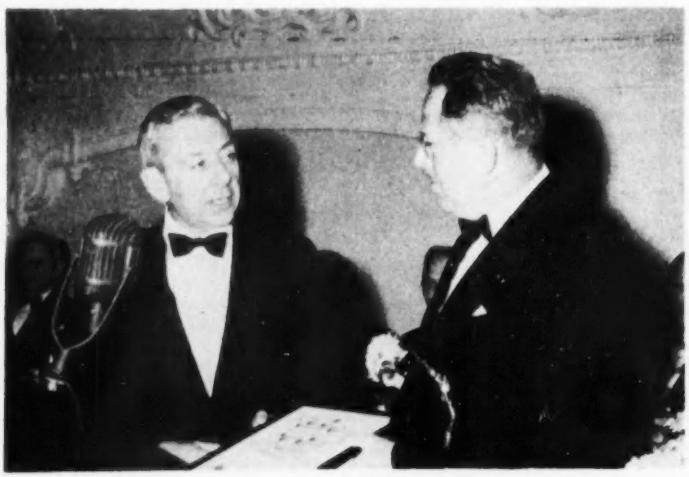
SAE Past-President C. F. Kettering, the banquet's chief speaker, credited the rubber and petroleum industries with a major part in development of the great automotive industry, said nothing has contributed so much to the economics of our food supply as the farm tractor . . . and said young engineers now coming along will contribute even greater technical progress in the future.

Presidents and staff executives of leading American and European engineering societies sat with SAE's past-presidents and current officers at a two-tiered speakers table which faced a capacity audience of 650 in the Knickerbocker Hotel's Grand Ballroom.

Led by SAE President D. P. Barnard, the members and guests began the banquet with a silent tribute to the late Stanwood W. Sparrow, who was to have been the chief speaker of the evening. (A copy of the talk Sparrow was to have delivered was presented to each dinner guest—and appears in full beginning on page 17 of this issue.) Barnard's opening words were:

> "As president of the Society of Automotive Engineers, I ask that we begin this banquet with a minute of silent tribute to our beloved friend and fellow engineer, a Past-President of SAE—Stanwood W. Sparrow."

Then came a welcome to the banquet from R. C. Wallace, chairman of the Chicago Section, under



One of the highlights of the banquet program was the presentation of a plaque by SAE President D. P. Barnard to C. S. Proctor, president, American Society of Civil Engineers, during which Barnard gave SAE's appreciation on the 100th Anniversary of the ASCE

C. F. Kettering (left) was the chief speaker at SAE's banquet at the Centennial of Engineering. R. J. S. Pigott was toastmaster. Both are past-presidents of SAE

whose auspices arrangements for the successful event were made.

Toastmaster was SAE Past-President R. J. S. Pigott, who is 1952 president of the American Society of Mechanical Engineers.

Barnard Sees More Miracles Ahead

Speaking briefly prior to Kettering's address, SAE President Barnard said that most of the engineering progress of the last 2000 years has been made in the last century. It was in 1855, he pointed out, that Professor Benjamin Stillman of Yale University made the first analysis of "rock oil" and proved that useful products could be made from it. . . . And the automotive industry, relatively young, has made very rapid progress since its start around the turn of the century.

"The automobile," Barnard said, "is now such a highly refined engineering achievement that it is hard to remember the laborious step by step development that has taken place in the past."

The public can well be optimistic, he continued, about future engineering progress. Our many scientific victories dangle before the nation and the world a promise of more and greater engineering

Turn to page 68

They sat at Speakers Table

at SAE Centennial of Engineering Banquet . . .

W. G. Ainsley
SAE Vice-President, Diesel Engine Activity

Dr. D. P. Barnard
SAE President

L. B. Bellamy
President, American Society of Tool Engineers

M. Berger
President, Belgian Royal Society of Engineers and Industrialists

E. C. Britton
President, American Chemical Society

Robert Cass
SAE Councilor

E. L. Chandler
Convocation Manager, Centennial of Engineering

H. E. Churchill
Chairman, SAE Meetings Committee

A. T. Colwell
SAE Past-President

H. E. Conrad
Executive Secretary, American Society of Tool Engineers

V. A. Crosby
SAE Vice-President, Engineering Materials Activity

G. E. Dunn
Former Councilor, American Meteorological Society

Linn Edsall
SAE Vice-President, Transportation and Maintenance Activity

V. M. Exner
SAE Vice-President, Body Activity

C. E. Frudden
SAE Past-President

R. E. Gay,
President, American Standards Association

E. F. Gibian
SAE Vice-President, Production Activity

C. G. Grove
Senior Vice-President, American Railway Engineering Association

Sir John Hacking
President, Institution of Electrical Engineers (England)

M. L. Haider
President, American Institute of Mining & Metallurgical Engineers

A. W. Herrington
SAE Past-President

Ed. Hianne
Managing Director, Societe Royale Belge des Ingenieurs et des Industriels

N. D. Howard
Secretary, American Railway Engineering Association

C. A. Hubert
SAE Vice-President, Tractor and Farm Machinery Activity

W. S. James
SAE Past-President

C. F. Kettering
SAE Past-President, Honorary Chairman, and Chairman of Executive Committee, Centennial of Engineering

Major L. R. Lohr
President, Centennial of Engineering

H. H. Morgan
Past-President, American Society for Testing Materials

Arthur Nutt
SAE Past-President

R. J. S. Pigott
Toastmaster, SAE Past-President and President, American Society of Mechanical Engineers

C. S. Proctor
President, American Society of Civil Engineers

Herb Rawdon
SAE Councilor

E. H. Robie
Secretary, American Institute of Mining & Metallurgical Engineers

Dale Roeder
SAE Past-President

D. G. Roos
SAE Past-President

A. J. Scaife
SAE Past-President

E. R. Seabloom
Second Vice-President, American Welding Society

D. R. Shoults
SAE Vice-President, Aircraft Activity

L. J. Sorenson
Past-President, Institute of Traffic Engineers

R. R. Teetor
SAE Past-President

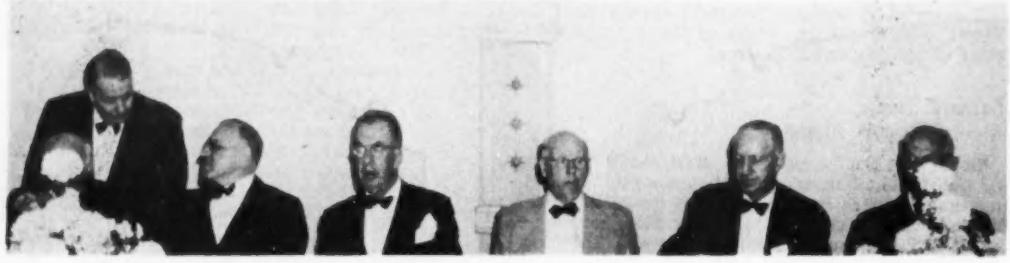
F. J. Van Antwerpen
Editor, American Institute of Chemical Engineers

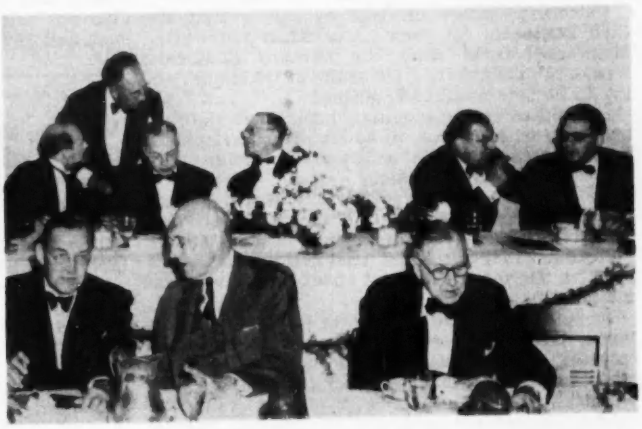
Georges Ville
Secretary, Societe des Ingenieurs Civils de France

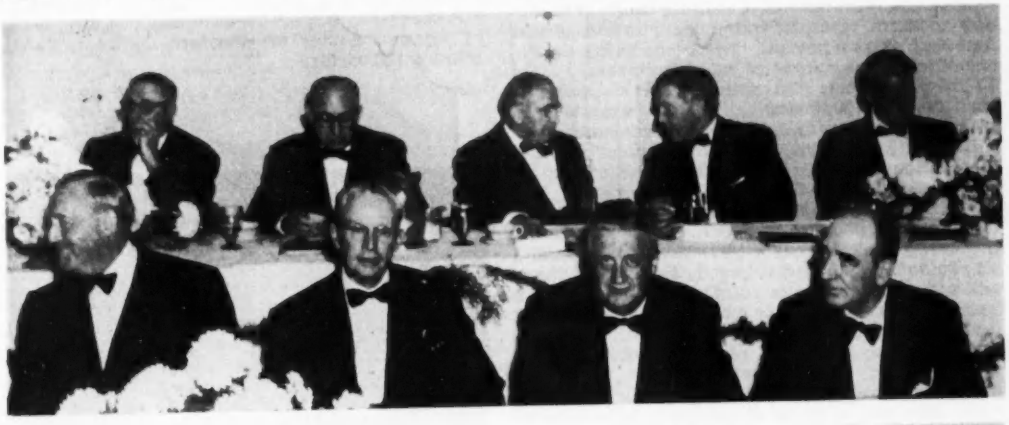
I. R. Wagner
President, American Foundrymen's Association

R. C. Wallace
Chairman, SAE Chicago Section

John A. C. Warner
Secretary and General Manager, Society of Automotive Engineers







Continued from page 65

miracles to come. "Just so long as one technical man somewhere in the world can visualize an opportunity," Barnard concluded, "so must the 'chain reaction exponent' of engineering remain greater than unity."

"Ket" Takes a Fore and Aft Look

Kettering started his talk by saying that the Civil Engineers got their name when founded to distinguish them from the Military Engineers. Now, a hundred years later, many of them are having to become military engineers.

He pointed up the essential character of the rubber and fuel industries in automotive development which has resulted in production of more than 120,000,000 vehicles to date.

He suggested that the people who disparage automotive engineers as "cut and try" artists do not understand the potency of experimental evaluation. "Why don't they talk about 'trial and success' methods," he queried, "instead of about 'trial and error' methods?"

He paid a tribute to automotive service and repair men. Every good service man has contributed something to the automobile, he said . . . "because when you're in trouble you'll think of almost everything."

There should be a monument to engineers who developed the farm tractor, Kettering said. "Production of farm tractors and mechanization of the American farm," he said, "has been, to my notion, one of the great contributions of engineers. . . . In 20 years the horse population of this country has gone down by 20,000,000. . . . That means we can feed 8,000,000 more people from the same acreage."

Kettering paid tribute to engineers of internal combustion machinery for making the equipment so easy to operate. "You don't have to get an engineer's license to run these things," he said, "because if you did, we wouldn't have many of them running. But here you can go out with a crawler tractor, and all you do is get in and somebody tells you to run it and you run it." He also pointed out that the little knowledge needed to drive a car or combine has had a terrific impact on the economy.

"I'm glad to see young men come into the engineering field," Kettering emphasized. "They will meet all us older fellows with big reputations. And when they get to know us, they'll wonder how we got them!"

We haven't reached a levelling off in engineering progress, Kettering assured his audience. Part of our progress is in the fact that we know today we have infinitely more problems than in the past. The automotive engineer still has a lot to do. . . . And the young men will bring in the new ideas that are needed.

The rapidity with which an industry keeps growing, he concluded, is based on the profit its customers make from the ideas and products it puts out. It is the profit the customer makes—not the profit the manufacturer makes—that determines progress.

Speaking of doing a job for the customer, Kettering said: "We're only interested in one thing. Would the fellow who bought the locomotive keep it? In one case we're in business, and in the other case we're out of business.

"Now I think that a great many people sit at desks. A man can sit in front of a big control board and, when he thinks of it, he flips a few switches. What you ought to do is to get behind there and see how few of them are connected to anything!"

How can the "customer profit" be determined? Kettering's answer is simple: "Let the customer think over in his mind how much more than the current price he would pay for the thing if he couldn't get another."

Members Make Banquet a Success

The General Committee for the banquet was headed by E. H. Kelley. Serving with him were SAE Meetings Committee Chairman H. E. Churchill, J. E. Kline, SAE Chicago Section Chairman R. C. Wallace and Floyd Ertsman.

The Reception Committee organized for the banquet by the Chicago Section Governing Board was headed by Wyn McCoy as chairman. Others on the Reception Committee were: O. A. Brouer, H. E. Churchill, J. T. Greenlee, M. L. Hamilton, J. E. Kline, F. B. Lautzenhiser, W. L. Rodgers, and T. A. Scherger.

Photographs for the historic banquet were taken by Norman Sauter of Standard Oil of Indiana's Whiting Laboratory.

Chicago Section Chairman R. C. Wallace opened the banquet with a welcome from the host Section. Wallace is executive engineer with Diamond T Motor Car Co.

Transmissions Today Are Still Not IDEALOMATIC

Bruce Edsall, Senior Project Engineer, Cadillac Division, General Motors Corp.

Based on paper, "The Idealomatic" presented at a panel meeting of the SAE Detroit Section, Jan. 28, 1952.

THE ideal passenger-car transmission or "Idealomatic" would provide all of these features without compromise:

- Completely automatic performance
- Maximum economy of operation
- Absolute smoothness of operation
- Competitive cost

But today no automatic transmission satisfies all of these requirements . . . all represent compromises which are inherent with a fundamental design. Advocates of such transmission features as fluid torque converters, gear ratios, fluid couplings, and lock-up clutches each place emphasis on a single advantage and minimize the advantage that an alternate design provides.

How far short of the Idealomatic do present-day transmissions fall? Let's take a look . . .

Automatic Performance

The Idealomatic would provide completely automatic performance. Thus it would be possible (1) to start, drive, brake, or reverse a car with no driver action other than manual selection of the transmission control; (2) while in "Drive" to power shift through any ratio change and automatically provide the driver with the correct ratio for maximum performance.

One of the Idealomatic's primary functions would be to provide maximum full-throttle performance automatically . . . but even it would be a compromise in this respect. Consideration would have to be given to the engine and its noise level characteristics.

The ability of a transmission to provide maximum tractive effort and its ability to provide this tractive effort automatically are two separate and distinct functions.

In many cases, particularly where a gear ratio, or a selection of gear ratios, is provided behind a converter, a manual shift must be made to get maximum tractive effort at low car speeds.

Even some fully automatic gear ratio type transmissions suffer a deficiency in this respect. Although maximum tractive effort is available when a car is accelerated from a standing start, it is not available after the transmission has once been upshifted and car speed maintained. At some car speeds, automatic downshifts are made into a higher gear ratio when a lower gear ratio would provide better performance.

Economical Operation

Still another requisite with the Idealomatic would be ability to make engines operate in their most economical speed ranges under normal road-load and light-throttle acceleration conditions. This implies need for an overdrive, friction horsepower characteristics of engines and limitations on low axle ratios being what they are.

Transmission efficiency would have to be maximum in this range, such as is provided by a lock-up clutch or partly mechanical drive. Particular emphasis would be placed upon a range of accelerator pedal travel in which the transmission stayed in an economy ratio. What's more, a range of torque multiplication would have to be provided between part-throttle and full-throttle performance . . . if the Idealomatic were to provide overall economical performance.

The requirement for infinitely variable torque multiplication for passing and grade climbing at part-throttle conditions is well met by present-day converters, but only partially met by automatic gear ratio selective systems.

Smooth Operation

Complete smoothness in transition from economy through mid-range to full performance operation is the third requirement the Idealomatic would have to meet. And meeting it would not be easy . . . if all the other features of the Idealomatic were to be retained.

It would require research and development to attain the absolute smoothness that exists in a fluid torque converter type of transmission. In fact, the object of every friction clutch enthusiast is to produce automatic shifts that equal the smoothness and response of a pure converter.

Specifically, the advantages that the pure converter holds in this respect are (1) ability to change ratio without a cessation of drive line torque, and

(2) direct and immediate response to a change of engine torque. Most friction clutch shifts require that drive line torque be instantaneously broken and response be provided by an outside control that attempts to sense engine torque change.

But, as mentioned previously, today's converter has a limited performance range and is unable to provide completely economical operation. This gives rise to the requirement for friction clutch shifts through geared ratios . . . and into lock-up clutches.

Competitive Cost

Needless to say, the Idealomatic would have to be competitive costwise—a factor which continually arises in designing present-day transmissions.

Other essential features would be overrun braking ability to permit coasting down grades, freedom from such disturbances as converter cavitations, whine, gear noise, hydraulic pump noise, and so forth.

In short, it becomes apparent that the future Idealomatic is going to require considerable development of, and possibly deviation from, the fundamental designs of today.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Turbine Designer . . .

. . must have intimate knowledge of both aerodynamic and mechanical losses existing within the machine in order to determine optimum design.

BASED ON PAPER BY **Sumner Alpert** Solar Aircraft Co.

AERODYNAMIC losses in gas turbines can be grouped into three classifications—friction, clearance and secondary or three-dimensional.

Friction losses comprise profile, or blade, losses and the annulus, or wall, losses. Profile losses result primarily from flow separation at the exit of the blades. The nozzle blades, with their highly accelerated flow, are quite efficient as long as they are subsonic, but in the rotor, profile losses are significant. There are two independent, though related, sources of profile loss. One arises from the thickness of the trailing edge and the other from early separation of the flow from the blade. In some respects the latter is a severe case of the former.

It is the turbine designer's goal to minimize profile losses by keeping the trailing edges of the blades as thin as practicable in the light of structural and fabrication considerations, and to eliminate separation. The latter phase requires careful attention to profile design and the use of the highest possible degree of reaction. The accelerating flow in a reaction turbine is the best deterrent to separation, provided the blades are designed correctly to eliminate velocity peaks.

Annulus friction losses arise from the flow over the walls of the casing. The lack of a smooth wall and the complicated path preclude any accurate analysis, but a working value is found by use of a friction coefficient.

Clearance losses arise from the leakage through clearance spaces provided between stationary and rotating elements. Great effort should be made to keep running clearances as small as possible in the mechanical design of the unit. In the case of tip clearance, it has been estimated that the amount of flow will be twice the expectation on the basis of the area involved. Flows through clearance spaces where seals are provided, such as labyrinth seals, can be analyzed by some empirical formulas available from steam turbine research. All clearance losses will be affected by the pressure ratio across the area concerned, hence in this respect the impulse turbine has an advantage over the reaction type.

Secondary losses come about in an engine in the same manner as in the elbow of a pipeline. As the flow turns a corner, the pressure on the inner wall drops, and rises on the outer wall. In the boundary layer on the end walls, the pressure gradient induces secondary flows. These secondary flows, which interact with the disturbed flow at the hub and the tip, due to clearance, cause the greatest portion of the losses in an axial flow turbine.

The net power output of an engine is the turbine output less the compressor work. Thus, an increase in turbine efficiency results in a larger work output. If we plot the net horsepower for a small representative engine against turbine efficiency, we find that an increase from 80 to 88% in turbine efficiency will result in a gain of more than 25% from the value at the lower efficiency. These figures illustrate vividly the importance of turbine design. (Paper, "Some General Considerations in the Design of Axial Flow Gas Turbines," was presented at SAE San Diego Section, Sept. 11, 1951. It will be printed in full in SAE Quarterly Transactions. It is also available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers).

Needs and Deeds Paraded at Tractor Meeting

"WE'VE done it before, now let's do it again," chorused a record-breaking 1039 off-highway equipment engineers at the National Tractor Meeting, Milwaukee, Sept. 8-11. Yesterday's needs have become today's deeds in many instances . . . but there's still lots to be done.

Goodyear president E. J. Thomas echoed the sentiments of all when he told a packed house at the banquet that the job is never finished. The phenomenal growth of farm mechanization during the past decade is something of which to be proud . . . and with continued progressive help we'll keep pace with all future requirements, too, said this top executive.

Recently completed "deeds" were paraded for inspection at several technical sessions. One attention-getter was a new sugar cane harvester that cuts, cleans, and loads cane—all in one operation. Described, too, were lightweight, hefty-output military construction equipment units that can be air-dropped.

And just as discussion of these new items carried over into hallway conversations and after-dinner chats, so did discussion of proposed ways to improve today's equipment suggested at other sessions.

Should farm tractors travel faster; be power-steered; and periodically tuned up? What can be done to boost the efficiency of their engine air cleaning systems? These were just a few of the subjects that excited comment at technical sessions and happenstance meetings of individuals.

"Say did you hear what so-and-so suggested?" was the stimulus that touched off many other corridor conversations as SAEer's and guests exchanged their thoughts on such matters as:

- Ways to avoid overloading tires on off-highway equipment
- Greater use of hydraulic torque converters in off-highway vehicles.
- A new approach for designing arch tractors.
- A more accurate formula to cope with the lesser ability of light, non-additive oils to provide scoring protection for gears.
- Aids for starting cold diesel engines.

Throughout the six all-day production panels on Monday (see pages 76-77), one theme persisted against the sharply contrasted problems of specialized areas. More and more designers and production men must work together. Better-performing, lower cost machines call for joint, rather than independent, effort.

This note crept into the technical sessions, too, where Foundry Magazine's W. G. Gude urged greater use of castings in tomorrow's tractors and farm machinery. He showed how postwar casting developments will be forcing the designer's hand in this direction. Here are a few he mentioned:

- The new cast-weld method of welding castings to each other, or joining castings to rolled steel parts, cut the cost of one tractor part by 38% and its weight 30%.
- Precision investment casting and shell molding are exciting farm equipment foundrymen. Both can handle ferrous as well as nonferrous metals, but high tooling costs and designs suited to the process are among factors to be reckoned with in the two processes.
- Nodular iron will be working its way into new parts, though it isn't replacing malleable iron as fast as expected. It will soon be in brake shoes, sprockets, motor blocks, crankshafts, and wheel hubs.

Sugar Cane Gets De-trashing

To many engineers, Thomson Machinery's new sugar cane harvester was a source of considerable interest. This harvester answers a long-standing need of the Louisiana sugar cane industry, noted Thomson president B. C. Thomson, for it not only cuts and loads cane but cleans it at the same time. And this is important, he pointed out.

Up to now, there's been no mechanical way to remove the tremendous amount of trash from cane . . . growers burn it off 24 to 36 hr after cutting the cane. Unexpected wet weather puts the damper on this operation, however, forcing mills to accept cane with all the trash on it.

The ability of this new harvester to harvest clean, fresh cane could result in yearly savings of $6.5 million to growers and processors in Louisiana alone, chimed in A. G. Keller, of Louisiana State University.

Tests conducted last year at LSU's Audubon Sugar

Around the Meeting . . .

C. W. Mork, Heil Co., (left) was general chairman of the 1952 National Tractor Meeting. Here he is shown with four of the five members of his General Committee. They are (left to right) E. F. Norelius of Allis-Chalmers; Milwaukee Section Chairman R. K. McConkey of Timken Roller Bearing Co.; and Merlin Hansen of John Deere Waterloo Tractor Works . . . Absent from the meeting because of illness was SAE Vice-President for Tractor and Farm Machinery Activity C. A. Hubert of International Harvester. McConkey opened the meeting on Tuesday morning with a very brief, but warm, welcome to members and guests.

The Tractor Air Cleaner Test Code subcommittee presented its final report to the Tractor Technical Committee at a meeting held during the Tractor Meeting. Here Test Code Chairman Wayne Worthington (left) explains final revisions to Tractor Technical Committee Chairman W. F. Strehlow . . . The Code is now being submitted to the Tractor Technical Committee for letter ballot before going to the SAE Technical Board. If approved by both agencies, the Code will appear in the 1953 SAE Handbook.

Dinner and meeting of the CIMTC Steering Committee has become an annual event during the Tractor Meeting. CIMTC Chairman Arnold F. Meyer, Jr., vice-president of engineering, Heil Co., presided and was host for the dinner. Guests in attendance included representatives of the Army Engineers' Corps, Navy Bureau of Aeronautics, and Department of Defense. (Meyers is seated third from the right.)

Factory showed that cane from the new harvester carried less than one-half the trash content of conventionally harvested cane. It also averaged only 1¼ days from harvester to mill instead of 3¼ days. What's more, the new machine delivered trash-free cane during rainy weather—a big factor in its favor, Keller added.

Still another approach to complete mechanical harvesting of sugar cane was outlined by International Harvester's J. L. Hipple. He told how a harvester under development by his company cuts, cleans, and loads 14 in. lengths of cane. It's important to cut cane in shorter-than-field lengths, Hipple stressed, because shorter lengths facilitate handling all the way down the line.

Parachuting Dozers

The construction equipment industry has also met a challenging need—the need for lightweight, high-performance construction equipment that can be air-dropped, noted the Engineer Corps' R. G. Alexander.

For a long time, the tactical advantages of airdropping complete, ready-to-go-to-work units have been recognized. And with the evolution of "flying boxcars" capable of carrying 8 ft high by 8 ft wide, 16,000 lb packages, the Army Field Forces set the wheels in motion. The special problems in developing such units were put squarely up to the construction equipment industry . . . and it come through in grand style, said Alexander.

The tractor industry, for example, licked the high performance vs low weight problem with crawler tractors. It takes horsepower to move dirt, earthmoving equipment designers knew. So what they did was design a 16,000 lb counterpart of the standard army 32,000 lb dozer, giving it the same horsepower as its big brother. Then to make up for lack of weight, they designed the new dozer to work at higher operating speeds.

To get the dozer weight down to 16,000 lb, designers came up with such weight-reducing schemes as skeleton construction, reduced-section dozer blades, and elimination of nonessential guards and accessories.

To date, one of these dozers, a 6-cu yd towed scraper, and a 14,-

500 lb motor grader have been dropped without mishap—a testimonial to their designers . . . and proof that today's needs can become tomorrow's deeds.

Just as increased speeds improved the performance of these lightweight military dozers, so would faster farm machinery pay off in many ways, two U. S. Department of Agriculture men told engineers at another session.

Faster farm tractors, for example, could be lighter and lower in cost, said E. G. McKibben and I. F. Reed, since operating weight of a tractor is determined by traction needs—not by strength of construction requirements. Farm implements drawn at higher speeds wouldn't have to be so wide to cover a given acreage. Hence, these units, too, could be lighter and less costly. And that's not all. Lighter tractors and narrow implements would handle easier.

However, if operating speeds are to be increased, tractor operation must be made less fatiguing—and power steering would help a lot. For that matter, there's a greater need for power steering in farm tractors than in passenger cars, declared McKibben-Reed.

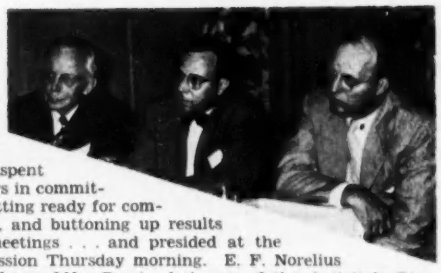
And on this point Saginaw's F. M. Ison was in strong agreement. Statistics show that wheeled tractors are driven about 634 hr a year on the average farm, he pointed out. This represents about 2½ months of 8-hr-a-day driving, much of which is over extremely rough terrain.

With power steering, the shock or "kick-back" of tractor driving would be largely absorbed and the physical beating taken by the driver greatly reduced, Ison observed. In fact, a farmer's teenage sons and daughters could handle the family tractor if it had power steering, thus relieving the farmer and/or saving the expense of hiring a man to drive the tractor.

Less driver fatigue would mean greater driver efficiency, too. And this would result in a greater return for a given amount of work or, stated another way, more work performed in a given time, he added.

These are just a few of the reasons why tractors used with front-end loaders especially need power steering, stated discussor L. B. Neighbour, of John Deere Spreader Works. Power steering

. . . Around the Meeting



Sherman C. Heth (center), of J. I. Case Co., who is vice-chairman for meetings of the SAE Tractor and Farm Machinery Activity, spent many man-hours in committee meetings, getting ready for committee meetings, and buttoning up results of committee meetings . . . and presided at the "sugar cane" session Thursday morning. E. F. Norelius (left), Allis-Chalmers Mfg. Co., is chairman of the Activity's Construction & Industrial Machinery Subcommittee. Merlin Hansen (right), John Deere Waterloo Tractor Works, is chairman of the Tractor & Farm Machinery Subcommittee. Heth also heads the Implement Subcommittee.

Once again, SAE Journal is indebted to C. T. ("Mike") O'Harrow and the Allis-Chalmers Mfg. Co. for most of the fine photographs which accompany this Tractor Meeting report. SAE Journal appreciates! . . . O'Harrow was chairman of the symposium on "Progress in Engine Protection by Air Cleaning" on Wednesday morning.

Here are four of the seven Canadian Section representatives who came to Milwaukee to study and observe Production Forum procedures. Canada will hold its first SAE International Production Meeting in the fall of 1953.

General Chairman for the International gathering will be R. W. Richards, vice-president, Goodyear Tire & Rubber Co. of Canada (left). Seated next to him is Malcolm Jolley, vice-president and general manager, Canadian Acme Screw & Gear, Ltd., who will be Forum

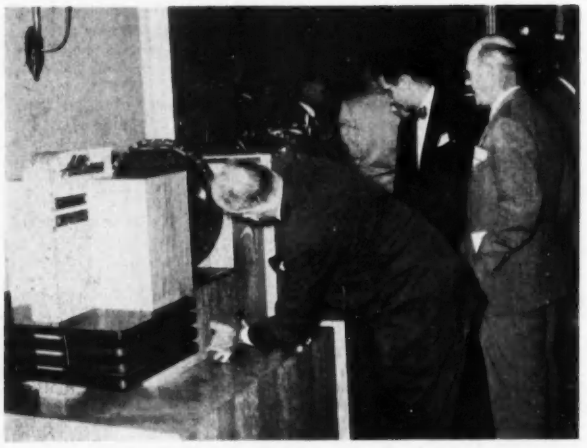
Chairman for the event. With them in the picture are A. A. Scarlett, vice-president of engineering, International Harvester Co. of Canada, who will be Canadian Section Chairman in 1953–54, and (right) A. Wallace Denny, vice-president in charge of production, Goodyear Tire & Rubber Co. of Canada, who is 1952–53 Canadian Section Chairman.

Other Canadians who accompanied them to Milwaukee were Marcus Brown, president, Seiberling Rubber Co. of Canada, who is currently a member of the SAE Production Activity Committee, and Alex Gray, vice-president and general manager, Gray Forgings & Stampings, Ltd.

Around the Meeting . . .

Gear experts, following the Thursday afternoon session, snatched up an opportunity to get the latest information on gear scoring from the eminent authority Harmen Blok, of Technical University, Delft, Holland. At this spontaneous get-together late in the afternoon were Wells Coleman, Gleason Works; E. J. Weflauer and W. P. Schmitter, Falk Corp.; R. P. Van Zandt and B. W. Kelley, Caterpillar; D. W. Dudley and J. P. Simon, General Electric; and K. F. Kemp and V. L. Rugen, of John Deere Waterloo Tractor Works.

Major J. L. Hight attended the Monday afternoon technical session where he showed a movie of the parachute drop of a 14,500 lb motor grader. Hight is the Air Force Development Field Representative at Army Field Forces Board No. 1, Fort Bragg. He personally supervises all experimental heavy drop work being conducted at Fort Bragg.



The opening session at which Allison's R. M. Schaefer talked on the effect of the hydraulic torque converter on power trains was attended by more than 300. The above explanatory display in connection with Schaefer's paper attracted much interest.

would also free one hand of the operator for gear shifting and loader control, and reduce the hazards of normal tractor-loader operation.

Power-steered, faster farm tractors may be just around the corner, but first several serious problems introduced by higher speeds will have to be solved, chimed in McKibben-Reed.

Really high-speed tillage can't be planned until engineers devise an effective and economical means for clearing fields of stones, stumps, and other obstructions. Neither can closely spaced operations, such as accurate placing of seed in drilled rows. Already the number of "planting" cycles per second is surprisingly large . . . but at 10 mph and 1 ft spacing, the cycle rate would be the same as the valves of a tractor engine operating at 1800 rpm.

Greater implement draft and damage to row crops with increased speeds are other problems designers would face, according to these USDA researchers.

Still another approach to improved farm tractor performance was suggested by two University of Nebraska engineers who urged periodic tune-ups.

Naturally tractors don't perform in the field as well as they do under carefully supervised laboratory conditions, noted C. W. Smith and L. F. Larsen, but periodic tune-ups will help them approach this ideal performance.

They cited a Nebraska Experiment Station Project which showed that tractors operated by 15 farmers averaged about 13% less power and 18% poorer fuel economy than laboratory-tested models. One tune-up, though, boosted both power and fuel economy of these tractors an average of 9%.

Thus farmers, by knowing when and what should be serviced—and performing this service properly, can do a lot to improve the operation of their tractors, maintained these Nebraskans.

Engines Still Eat Too Much Dust

One thing farmers have little or no control over, however, is the effectiveness of engine air cleaning systems. And everything possible must be done to keep dust out of tractor engines, stressed Massey-Harris' E. S. Dahl and K. H. Rhodes. Regardless of particle

size or engine operating conditions, every gram of dust an engine has to swallow causes considerable wear. Consequently, there's always room for improvement in air cleaning systems . . . and here's how to do it said other engineers.

Until such time as new and better air cleaners are perfected, improvements in air cleaning systems should stem from combinations of the three well-known filtering devices, declared United Specialties' D. P. Eastman. Combinations of precleaners, oil-bath air cleaners, and aftercleaners in series really do a superior dust-removing job.

Using an inertia-type precleaner with the regular oil-bath air cleaner, for example, cut by 61% the amount of dust that ordinarily would have entered the test engine, he reported. A porous wall aftercleaner, coupled in series with the oil-bath unit, reduced dust flow 64% . . . and a combination of all three eliminated 73% of the foreign matter that would have entered the engine.

But efficiency shouldn't be the sole criterion for judging air cleaners, noted Fram's B. G. Brown. More emphasis should be placed on the size of dust particles that pass through a cleaner. An air cleaner with 97% efficiency which removes all but the very finest particles may protect an engine better than one with 98% efficiency which allows some of the larger particles to reach the engine.

Locating the inlet to the air-cleaner intake system in a high position at the extreme front of the tractor will help, said Donaldson's R. E. Larson. He cited these Phoenix, Arizona, test results:

- Dust pickup at an elevation 114¼ in. above ground level was 15% less than at 96¼ in.; 55% less than at 81¼ in.; and 206% less than at 64 in. or hood level.
- At hood level, dust pickup at a forward position was 47% less than at a position 30 in. to the rear.
- Combining the effect of elevation and forward position, dust pickup up front at hood level was only 10% more than at a position 31½ in. higher.

An air inlet location—remote from the air cleaner—drawing relatively clean air might appear then to be the answer, Larson went on. Unfortunately, however, ducting of air from a remote position requires use of bends and/or elbows . . . and these interfere with free flow of air to the cleaner, thereby cutting air-cleaner efficiency.

In short, it's not just coincidental that radiators are located at the front of a tractor; controls located within easy reach of the operator; and the drawbar located at the rear. Why then isn't it natural for the air cleaner to be located at an extreme forward position and be equipped with a straight-through extended inlet, queried Larson.

Give Tires a Chance

Vehicle designers should take a more realistic view of tire loads on off-highway vehicles, too . . . especially since the trend is toward units that can haul bigger loads at higher speeds for longer distances, stressed Firestone's L. W. Fox.

All too often production vehicles are heavier than drafting board versions or pilot models, he asserted. Designers underestimate stresses, requiring a strengthening of the vehicle at certain points. The sales department decides before a pilot model can be thoroughly tested that—for competitive reasons—it must have a few more yards capacity or 10 to 15 mph more speed. All these things add up to a higher gross weight—and frequently to a serious tire overload situation.

Fleet operators, too, ought to give the tires on their off-highway equipment a better break, continued this tire engineer. Time and again, they don't limit loads to vehicle rating, select the right capacity and type of tire, maintain haul roads, mate dual tires properly, maintain recommended pressures, and inspect regularly for damaged tires.

It's not out of reason to haul big loads at high speeds for long distances in off-highway vehicles, but Fox pleaded: "Let's all team up to give properly chosen tires a chance to show what they can do."

Use of hydraulic torque converters in off-highway vehicles is another way to keep operating costs down, according to Allison's R. M. Schaefer. Power train components of torque converter-equipped trucks last appreciably longer than those in trucks with mechanical drives.

In support of his contention, Schaefer cited field test results which showed 47% more engine life, 400% more transmission life, and 93% more differential life for converter-equipped trucks used in earthmoving, coal, and ore hauling operations.

To Hyster's H. F. Wahl, designers of arch tractors would be wise to use a new approach. Far too many tend to consider the obvious and overlook basic hidden factors in designing these logging vehicles.

Mother Nature has created two forces that do not

Continued on Page 78

Technical Sessions . . .

. . . started on time, then came off smoothly, thanks to these

session chairmen:

D. W. Erskine—Tuesday morning
M. R. Bennett—Tuesday afternoon
C. T. O'Harrow—Wednesday morning
F. W. Duffee—Wednesday afternoon
S. C. Heth—Thursday morning
Merlin Hansen—Thursday afternoon

Journal Presentations . . .

. . . of technical papers will cover all sides of all issues, thanks to these

session secretaries:

L. W. Nelson—Tuesday morning, afternoon
D. F. Semlak—Wednesday morning
Gordon Barrington—Wednesday afternoon
M. H. Ririe—Thursday morning
Igor Kamlukin—Thursday afternoon

Chief planners of the Milwaukee Production Forum were General Chairman M. L. Frey (center) and his assistant Norman Mollinger (right). SAE Vice-President Emil Gibian (left) heads up the Production Activity Committee which sponsored the Forum

Milwaukee Repeats Production Forum

MILWAUKEE's repeat performance of the SAE Production Forum furnished an even more solid technical fare than its first showing last year. Established at the '51 Forum, the informal give and take of ideas moved at a more sure-footed pace this year. Manufacturing-minded men swapped what-to-do's and how-to-do-it's on problems ranging from gear distortion to lowering high rejection rates.

Users and producers got a clearer picture of each other's problems. Designers and fabricating men cleared up common concerns. Men with similar responsibilities from different companies compared notes on their techniques and procedures, and came away more knowledgeable on what will or will not work in specific cases.

Interest ran high in all six panels. Intimate groups at the welding, forging, materials handling, and quality control panels kept the panel specialists on their toes as they queried, agreed, and differed with them.

The particularly large number of participants at the gear and heat-treating panels extracted a wealth of data from each other. They repeatedly underscored gear distortion as chief ulcer-producer amongst heat treaters. Discussers suggested better process and materials controls as ways of side-stepping such troubles. For example, if high carbon content steels bring excessive distortion, go to lower carbon materials.

Some argued that it's cheaper to correct distortion than to try to prevent it.

Panel members also said industry is learning how to live with distortion-susceptible boron steels. Metallurgists are learning of this steel group's limitations and designers are finding where the borons best can be used.

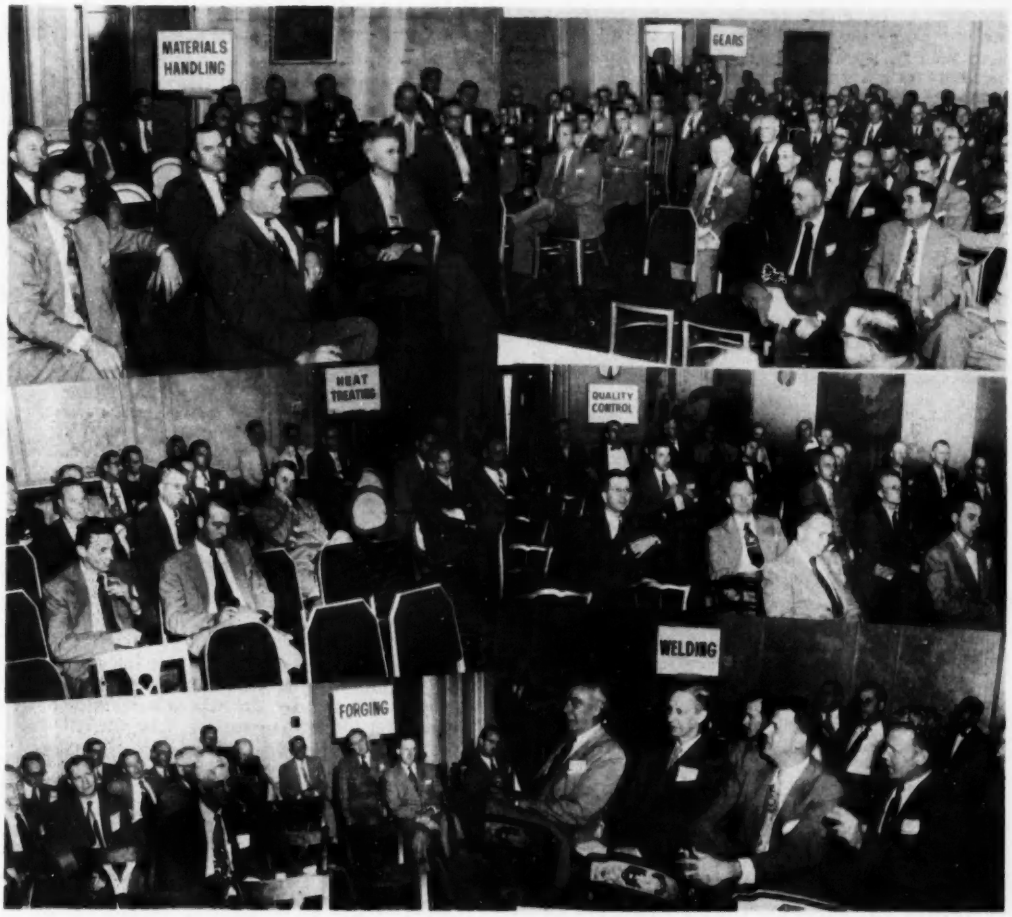
These and many other ideas soaked up by participants at the Production Forum at Milwaukee will be presented in on-the-spot reports in forthcoming issues of the SAE Journal.

The Men Who Led and the Men

Heat-Treating
Secretary R. Ulichney
Leader J. E. Schoen

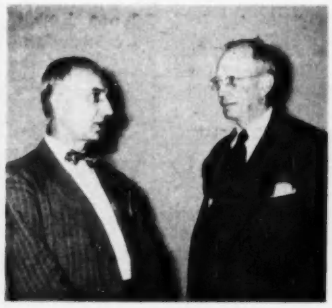
Materials Handling
Secretary F. D. Gunderson
Leader M. A. Travis

Welding
Secretary H. Hammer
Leader J. J. Chyle



Who Reported Panel Discussions

Gears
Secretary M. Barker
Leader B. W. Keese



Forging
Secretary L. L. Bower
Leader E. O. Dixon

Quality Control
Secretary I. W. Schoeninger
Leader H. A. Weissbrodt

exist on a designer's drawing board—the force of gravity and the unpredictable operator. And these two factors, working together or individually, can account for more transmission failures than obvious design considerations, Wahl observed.

Just as performance of arch tractors is affected by hidden factors, so is scoring of gears, Caterpillar's B. W. Kelley told engineers at another session. In fact, lack of specific knowledge of lubrication is the most important reason why scoring phenomena have not been adequately expressed in a formula, he pointed out.

Designers must rely largely upon purely empirical formulas to cope with the lesser ability of light, non-additive oils to provide scoring protection for gears. And while surface temperature has been implied in most of these formulas, it is not adequately treated . . . and effect of bulk oil temperature has been almost entirely ignored.

Yet temperatures above may well prove to be the basis for failure of straight mineral oils, Kelley contended. Caterpillar tests on balls, rollers, and gears have confirmed the postulate of Harmen Blok, of Delft University, that straight mineral oils have critical temperatures at which they will fail, depending only on their viscosity.

He told how Caterpillar engineers had started out with Blok's original formula . . . then introduced an empirical term to take into account the effect of surface finish on scoring resistance. And while discussor and formula-originator Harmen Blok agreed this was a step in the right direction, he felt that the expression for surface finish should be broken down into more general terms. In short, it should be less empirical and more qualitative.

Lubricant viscosity is one of the critical factors in starting cold diesel engines, too, added Caterpillar's D. E. Kilty, N. K. Lammers, and K. J. Fleck. To assure correct engine lubrication, it shouldn't exceed 20,000 SUS at the time of starting . . . and one way to meet this requirement is to use special engine heating aids.

Temporary use of ether in the air supply or glow plugs in the combustion chambers—together with electric or air starting systems—will provide good starting down to 0 F, this trio pointed out.

For starting at temperatures as low as – 25 F, an auxiliary gasoline engine was suggested as a practical solution. Not only does its rejected heat warm the jacket water of the diesel and its exhaust heat the diesel intake air, but it offers an unlimited cranking period, they said.

Below – 25 F, some kind of standby or quick warm-up heating system is necessary, and the diesel engine itself shouldn't be overlooked.

A combination gasoline engine and hydro-kinetic absorber makes an excellent quick warm-up heating system, too, added Thompson Products' J. H. Booth. Developed for the Navy, this type of unit heated one large tractor engine 210 F in 6½ min.

Providing heat externally or internally is one way to attack the problem of starting cold diesel engines . . . another is the "strong arm method" or power approach, chimed in discussor R. W. Beal, of the Engineer Corps. Engines can be started by using greatly increased cranking capacity and highly volatile fuels, but is this method too hard on engines, he wondered.

Goodyear Chief

E. J. THOMAS, president, Goodyear Tire & Rubber Co., told how men can increase their usefulness to their companies and themselves in his address to the Tractor Meeting Dinner which was attended by more than 300.

General Chairman G. W. Mork, Heil Co., opened the dinner with a few words of welcome to the audience and introduced Toastmaster F. M. Potgieter, Mechanics Universal Joint Division, Borg-Warner Corp.

SAE President D. P. Barnard, in a brief talk, pointed out that more than half the world's population today cannot ask the question "What shall we have for dinner?" which we in America ask every day. Rather their question is "Will I eat today?"

The first revolution which really created human economy, he went on to say, was that which gave man control over his food supply. And once man started to plan, control and augment his food supply, he began to live with more security and his standard of living improved. Then the invention of the plow made another important revolution . . . and now the modern farmer using a tractor can support not only himself, but many other persons besides.

Fundamentals subject to individual control which will greatly enhance anyone's chances for success, Thomas said are health, character, ability, teamwork, and thrift.

To these fundamentals, other things may well be added, Thomas suggested, saying in part:

"A cheerful countenance attracts friends and breaks down barriers. . . . We advise our men not to sit back and wait for people to speak to them. Take the initiative in this. You'll be surprised how it widens your circle of acquaintences and increases your leadership.

"We can find men who can do specific jobs requiring specialized training. You'll be surprised how difficult it is to find real leaders, who can intelligently direct the efforts of other men . . . men who think in terms of what they can do for the company instead of what the company can do for them. . . . I see no lack of opportunity ahead in business for men who can exercise real leadership. We never seem to have enough.

"Most young men in their early years should be more interested in what they can learn than in what they can earn.

"Many men come in with a half-baked recitation of the problem and then dump it in your lap for a decision. . . . I like the fellow who comes in, makes a thorough presentation and says: "Based on that, here's what I think we ought to do."

Spots Road to Opportunity at Tractor Dinner

E. J. Thomas (left) president, Goodyear Tire & Rubber Co., was the chief dinner speaker. F. M. Potgieter (center) Mechanics Universal Joint Division, Borg-Warner Corp., was toastmaster, and SAE President D. P. Barnard, Standard Oil Co. (Indiana) spoke briefly

Just prior to the dinner the four SAE Past-Presidents who were at the speakers table foregathered with SAE Secretary and General Manager John A. C. Warner. A. T. Colwell (center) has just received a negative answer to his question: "Have you heard the one about . . . ?" Left to right: C. E. Frudden, Warner, Colwell, W. S. James, and Dale Roeder

General Chairman of the Meeting G. W. Mork (right) chats with two distinguished educators just prior to the dinner. With him are (left) W. D. Bliss, dean of engineering, Marquette University, and (center) M. O. Withy, dean of engineering, University of Wisconsin. Mork opened the dinner with a brief address of welcome

TECHNICAL COMMITTEE *Progress*

1952 SAE Technical Board

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In the works:

Helicopter-Engine Specification

THE SAE Helicopter Committee (S-2) has organized a subcommittee to develop a report setting forth the characteristics required in powerplants used on helicopters. This work is being undertaken at the request of helicopter manufacturers, who have found that present-day engines, built primarily for fixed-wing aircraft, do not give maximum efficiency and best possible service when used on helicopters.

The helicopter engine, for example, must operate at a more nearly constant speed than engines used on fixed-wing airplanes. It is also frequently necessary to add a flywheel to the engine when it is used on a helicopter, to take care of the omission of the propeller.

Helicopter manufacturers feel that production of this type of aircraft has reached the point where volume justifies building engines to meet their special requirements. Moreover, there is some feeling in the industry that in a few years the helicopter may be the biggest user of piston engines.

R. D. Lanning, Piasecki Helicopter Corp., is chairman of the subcommittee of the SAE Helicopter Committee that is working on the helicopter-engine report

As its first step in developing its report, the newly organized Powerplant Subcommittee has drawn up a list of characteristics considered essential in engines used in helicopters. The list covers carburetion, cooling, performance, and engine design modifications.

At the third meeting of the subcommittee, which was also attended by members of the engine industry, possible solutions to some of the problems were suggested.

The lone phase of the report that seems to have aroused some debate concerned the inclusion of a section on powerplant packages. It was finally agreed that such a section should be included, but it would consist merely of a list of the components to be contained in a powerplant package, and that the list would include the following items:

1. Engines.
2. Cowling.
3. Fan.
4. Oil cooler.
5. Induction system ducting.
6. Carburetor air filters.

It was pointed out that one engine manufacturer is already offering such a package and two others are actively engaged in the development of packages of their engines.

The subcommittee discussion also covered engine operating schedules for helicopters. It was pointed out that the present qualification test for helicopter engines requires approximately 35% more horsepower-hours than for fixed-wing aircraft. The members of the engine industry asked that a meeting be held to establish a realistic schedule of operation for helicopters. It was felt that some of the requirements were too severe, while the helicopter builders would like to see an increase or a revision of some of the others.

Chairman of the subcommittee is R. D. Lanning, Piasecki Helicopter Corp.

Spec Proposed For Copper Tubing

A PROPOSAL for an SAE Standard on copper tubing to be used in conjunction with the tube fittings now listed in the SAE Handbook has been developed by a subcommittee of the SAE Tube, Pipe, Hose, and Lubrication Fittings Committee. G. C. Vahrenhold is chairman of the subcommittee.

The specification covered by the proposed standard covers temper, chemical composition, tensile properties, workmanship and finish, dimensions for standard sizes, expansion test, and pressure proof test.

Originally, this specification was drafted to take the place of SAE No. 75 copper tubing. After discussion with members of the SAE Nonferrous Materials Committee, it was felt that this specification should be considered as a new standard independent of SAE No. 75 and, if adopted, should be placed in the SAE Handbook with the rest of the material on tube fittings.

Auto Drafting Standards Now in Second Edition

AFTER two years on the market (and 2500 sales), the first edition of the SAE Automotive Drafting Standards has been retired to make way for a revised and enlarged edition. The new edition contains 10 new sections, as well as the 21 old ones. On the whole, only minor revisions have been made to the latter.

The new sections are:

1. Body Outline and Seating Diagrams. Diagrams are presented to show the dimensions that should be considered in the design and manufacture of automobile bodies, and to serve as functional guides. Included also are diagrams giving accepted standard dimensions of the average human being.

2. Placement of Body Draft Views. Four figures are used to show the master body and sheet metal layouts. It is suggested that other layouts follow the same general plan.

3. Body Construction. This section shows typical sections taken through many parts of the body. Other views show the construction of welded joints, trim fastenings, and mountings with body holddown bolts.

4. Body Mechanisms. Illustrated here are such body mechanisms as hold-open devices, hinges, locks, window regulators, convertible tops, and auxiliary power units.

5. Body Silencing and Sealing Materials. This section covers silencing and sound deadening materials, weatherstrip and sealers, welding primer, gaskets, welts, and cement.

6. Metal Stampings. This section gives many design hints that should facilitate the construction of the dies.

7. Forgings. Notes are given on forging equipment and processes, forging dies, and forging design.

8. Gears. This standard has been established to define the basic minimum drawing information for the manufacture and inspection of gears, and to indicate optional information frequently required for a more specific definition of process control or product quality.

9. Splines and Serrations. This section gives general information on the use of involute splines and serrations. Specimen drawings are included, with complete dimensioning and spline data.

10. Plastics. Tables giving physical properties and representative applications of common molded plastic materials are included. Data are also given on forming processes, coating, painting, machining operations, designing molded parts, assembly methods, shrinkage and tolerances, and a variety of design hints.

The section on abbreviations and symbols has been completely revised and all sections have been changed to comply with the coordinated list of abbreviations agreed on jointly by the Automotive Drafting Standards Committee and the Aeronautical Drafting Manual Committee.

Apart from this, only minor revisions have been made to the old sections.

In addition to the new sections, the manual contains sections on castings, springs, powder metallurgy, surface finish, chassis frames, and fundamentals. The sections on the fundamentals contain material on drawing forms, lines, lettering, sectioning, projection, dimensioning, tolerances, screw threads, drawing revisions, and checking.

The "SAE Automotive Drafting Standards," which is prepared for insertion in a 3-ring binder, costs $5. It may be obtained from the SAE Special Publications Department.

22 AMS Approved By Technical Board

- AMS 2221B—Tolerances, Copper and Copper Alloy Rods and Bars;
- AMS 2222B—Tolerances, Copper and Copper Alloy Plate, Sheet and Strip;
- AMS 2223B—Tolerances, Copper and Copper Alloy Seamless Tubing;
- AMS 2224B—Tolerances, Copper and Copper Alloy Wire;
- AMS 2251C—Tolerances, Alloy Steel Bars;
- AMS 4230B—Aluminum Alloy Castings, Sand;
- AMS 4283B—Aluminum Alloy Castings, Permanent Mold;
- AMS 5010D—Steel, Screw Stock;
- AMS 5050E—Steel Tubing, Seamless, Low Carbon, Annealed;
- AMS 5358—Steel Castings, Precision Investment, Corrosion Resistant;
- AMS 5530C—Alloy Sheet, Corrosion and Heat Resistant, Nickel Base;
- AMS 5689—Steel Wire, Corrosion and Heat Resistant;
- AMS 5723—Steel, Corrosion and Heat Resistant;
- AMS 5831—Alloy Sheet, Corrosion and Heat Resistant, Iron Base;
- AMS 6266B—Steel;
- AMS—6422A—Steel;
- AMS 7205—Spring Pins, Steel;
- AMS 7211—Cotter Pins, Steel, Corrosion and Heat Resistant;
- AMS 7232B—Rivets, Alloy, Corrosion and Heat Resistant, Nickel Base;
- AMS 7496A—Rings, Flash Welded, Carbon and Low Alloy Steels;
- AMS 7490A—Rings, Flash Welded, Austenitic Corrosion and Heat Resistant Steels;
- AMS 7493A—Rings, Flash Welded, Non-Austenitic Corrosion Resistant Steels.

Phillips Succeeded by Rooke as E-21 Chairman

E. M. Phillips (left) of General Electric has retired as chairman of Committtee E-21. Norman F. Rooke (right) of Pratt & Whitney Aircraft is the newly elected chairman. Committee E-21 is the General Standards for Aircraft Engines Committee of the SAE Aircraft Engine Division. The Committee is currently at work on development of an ARP on propeller attachments for advanced powerplants, revision of AS 107, Surface Finish, additions to ARP 341A, Nomenclature Guide for Aircraft Engine Parts; definitions for performance characteristics of turbine engines; and a standard for engine pads for compressor bleeds—among other projects

These reports have recently been approved by the SAE Technical Board . . .

NONFERROUS MATERIALS CONSERVATION—A report on Conservation of Nonferrous materials in Military Vehicles. This work was undertaken by SAE at the request of the Office of the Chief of the Bureau of Ordnance, and the report has been delivered to that Office.

RADIATOR FILLER NECKS—A new SAE Recommended Practice for Large Size Radiator Filler Necks, which was developed by the Radiator Filler Necks Subcommittee of the SAE Engine Committee. This SAE Recommended Practice was developed primarily for use in military vehicles which require exceedingly strong installations. It is expected to have only limited use on commercial vehicles.

AGRICULTURAL TRACTOR DRAWBARS—Revisions in the SAE Standard for Agricultural Tractor Drawbars. These changes revise the standard so that it takes into account loads imposed on implements as well as tractors. They originated in the Farm Equipment Institute, which submitted them to the SAE Tractor Technical Committee.

BRAKE LININGS, RIVETS, AND BOLTS—Revisions to Part II and a new Part III for the former SAE Standard for Brake Linings, Rivets, and Bolts. At the same time, the Board accepted the SAE Brake Committee's recommendations that:

- Part I, the revised Part II, and the new Part III be combined in a SAE recommended practice under the heading "Brake Linings."
- Part III of the present standard be designated a SAE standard under the heading of "Rivets for Brake Linings and Bolts for Brake Blocks."

INVOLUTE SPLINE AND SERRATION GAGES AND GAGING—a new SAE Standard, on the recommendation of the SAE Parts and Fittings Committee. This standard supplements the involute spline and serration standards already published in the SAE Handbook on pages 521-604.

SAE Aircraft Engine

Committee E-25

THANKS to the U. S. Navy, Committee E-25 of the SAE Aircraft Engine Division met August 18-21 at sea on the carrier Midway. Sessions on engine and propeller standard utility parts were sandwiched in between periods of observing carrier operations.

Despite the fascination of the intense activity on the Midway, the Committee managed to review everything on its agenda. Two among the 44 items were:

- A report that, in recent Air Force tests, carbon-restored bolts did not compare favorably with ground bolts. (Purpose of the carbon restoration is to replace surface carbon lost in heat-treatment. Restoration is of interest because it is thought to be more economic than grinding away the decarburized metal.) Discussion of the report disclosed that tests conducted by the Navy and by a bolt manufacturer confirm this conclusion. Potentialities of carbon restoration were, however, considered significant enough to warrant further study.

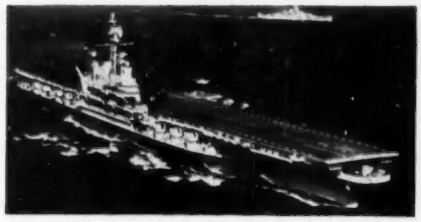
- Setting up of a temporary subcommittee to study possibilities of standardizing self-locking nuts.

The meeting was arranged through the office of Admiral T. S. Combs, Chief of the Bureau of Aeronautics, and A. S. Hanson.

Those attending the meeting were Chairman R. C. Rethmel of the USAF, W. B. Billingham of Hamilton Standard, Gustaf Carvelli of Wright Aeronautical, G. N. Cole of Pratt & Whitney Aircraft, S. N. Dexter of General Electric, H. M. Favor of Aeroproducts, P. B. Freeman of Fairchild Engine Division, G. M. Garcina of Allison, E. F. Gowen of Standard Pressed Steel, A. S. Hanson of the Navy's Bureau of Aeronautics, A. Hasbrouck of Pratt & Whitney Aircraft, D. L. Kidd of Air-cooled Motors, H. A. McFarland of General Electric, M. E. Mills of Elastic Stop Nut, F. H. Norriss of Westinghouse, J. B. Reese of Curtiss-Wright Propeller Division, R. F. Schwarzwalder of Wright Aeronautical, and D. H. Secord of Pratt & Whitney Aircraft.

Division's

Meets on Carrier Midway



Hear Ye, All Landlubbers
This is to certify that
R. C. Rethmel

attended the August meeting of SAE Committee E-25 on the dates 30-31 August 1952, held aboard the U.S.S. Midway operating in the Norfolk area

Let it be known that this person, was witness to carrier operations aboard said ship and disembarked in true naval fashion, thus qualifying him to become a member of the

Society of Seasick Aviation Experts

with all rights and privileges befitting such an honor

Be it remembered that distinguished members of this organization shall hereafter be entitled to:

Punch on the pilot's nose
Paint the waterlines
Walk the plank

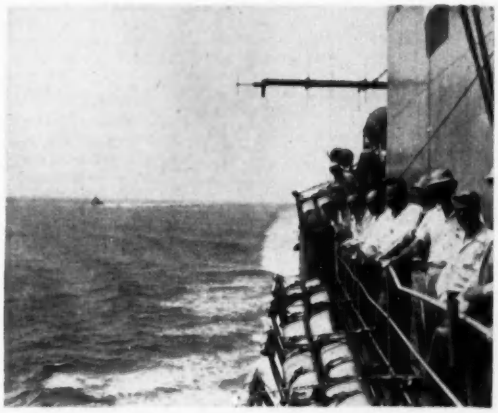
Wear Irish geometry
Drink raw bourbon at prop wash
Lay off on the forecastle

Be it known that this certificate is awarded with special citation for engine and propeller standard parts design experts who knowingly dared fly behind engines and propellers containing A.E. (Subcom. E-25) utility parts.

Executive Officer

Commanding Officer

Although Committee E-25 members claim no one suffered mal de mer, their Navy hosts had prepared for them certificates in a new "SAE"—the Seasick Aviation Experts. According to the certificates, members are entitled to such privileges as walking the plank and drawing prop wash by the bucket



Here the SAE men take time out from watching flight deck take-offs and landings to watch a destroyer being refueled from the carrier. On the other side of the tower, jet fighters were being catapulted from the forward end of the deck and propeller aircraft were taking off simultaneously

Posing in front of an F9F Pantherjet are (standing, left to right) Cole, Rethmel, McFarland, Carvelli, Billingham, Mills, Reese, Garcina, and Freeman. In the front row are Hasbrouck, Dexter, Norris, Stoner, Hanson, Favor, Schwarzwalder, and Kidd. Gowen and Secord weren't around when this was taken

How the Pantherjet's dive brakes work is explained to a group being shown around the hangar deck of the Midway by the hangar deck chief. The tour provided opportunity to observe maintenance, servicing, and storing operations. Halftone photographs on this page are official U. S. Navy photographs

Dimensioning Across the Sea

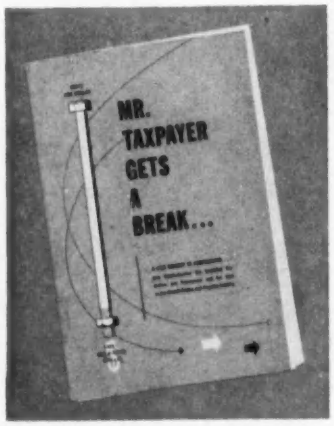
DIMENSIONING across the sea became an accomplished fact several months ago as far as turbine engine airfoil blades and vanes are concerned. At that time the Society of British Aircraft Constructors published the British equivalent of the SAE Aeronautical Recommended Practice ARP 265, which provides a standard method of dimensioning turbine engine airfoil blades and vanes.

The British and American standards were brought into conformity quite easily by the informal, but direct, transmittal of information from one country to the other at the working level.

ARP 265 was completed over a year ago by a group of American turbine engine specialists, at the request of the Aircraft Industries Association. John R. Dziel was chairman of this group, which was a subcommittee of the SAE Aeronautical Drafting Committee. The need for such a standard in this country was brought out at an AIA production methods meeting early in 1950. Those attending this meeting emphasized that such a standard was needed before high-production inspection equipment could be developed for blades.

After the June, 1950, SAE Journal announced the functioning of the American group, the British Joint Services Mission in this country requested the SAE group to keep them posted on the detail progress of their work, inasmuch as this subject was of vital interest to the British group. The Americans fulfilled this request by forwarding reports of meeting minutes and current progressive proposals.

Starting in May, 1950, the SAE group held 13 consecutive monthly meetings, and hence was able to comply with the AIA request. It was also pleased to forward this much-needed information to the British.



AIA's new booklet telling how standardization of aircraft engine and propeller parts is cutting costs of building and maintaining military aircraft

Standard Utility Parts Save Millions in Taxes

• Since 1948, 54,105 man-hours of SAE Committee E-25 work have resulted in 251 completed recommendations for 19,410 standard parts.

• Because of industry-wide usage, standardized items are produced in greater volume than the single-purpose company parts they replace. This lowers the per-unit cost of these items. A typical engine bolt and nut costing $2.63 before standardization are now manufactured for $1.

• Quantity usage of this bolt and nut this year will bring the savings to an estimated $1 million on these two items alone.

These facts apear in a booklet "Mr. Taxpayer Gets A Break," which the Aircraft Industries Association has just issued. The booklet emphasizes the cost reductions achieved through Air Force - Navy - industry teamwork in standardizing aircraft engine and propeller utility parts.

Top leaders of the military services and industry agreed in 1947 that industry should be responsible for development of aircraft engine and propeller standards, the AIA publication explains. At the request of AIA, SAE undertook the assignment and set up Committee E-25 of the Aeronautics Committee's Engine Division to do the job. Composed as it is of engineers from each of the manufacturers as well as from the Air Force and the Navy, E-25 "has demonstrated by its record to date what the philosophy of teamwork can accomplish," AIA says.

Besides increasing manufacturing efficiency, standardization of utility parts simplifies procurement of spares and reduces small-parts inventories, the booklet points out.

Although the booklet doesn't mention it, much of the success of the standards developed by E-25 is due to AIA's thorough handling of the exchange of information about standardization proposals between all segments of the industry and to AIA's continuing support of E-25.

The booklet will be sent to Government officials, the trade press, and AIA members.

John R. Dziel, chairman of the subcommittee of the SAE Aeronautical Drafting Committee that developed ARP 265 on dimensioning of turbine blades and vanes

Prop Attachment Spec Is Nearing Completion

THE SAE panel working on a recommended practice for turboprop-propeller attachments has high hopes of having the document ready to submit for approval by the end of 1952.

The design the panel expects to propose as an SAE Aeronautical Recommended Practice includes (1) a large propeller flange which will bolt to a pad on the engine housing and carry the major portion of the loads imposed by the propeller and (2) a spline connection to transmit engine torque. Flange, bolt, and spline dimensions have been worked out for flanges with 22, 26, and 30 in. bolt-circle diameters.

One of the last major problems confronting the panel was that of taking care of eccentricities between mating engine and propeller assemblies. The approach on which the panel is now basing its work is the establishment of a set of limit loads and moments which the propeller may apply to the engine spline. If necessary to keep the propeller-applied loads within the limits, a flexible coupling may be incorporated.

Last spring the panel agreed that the proposed ARP shall call for seals to be provided on each end of the propeller spline and a damming device near the outboard seal to maintain the lubricant to the inner surface of the splines.

Need for the new type of attachment stems from the increased loads which will be imposed by tomorrow's large turboprop engines and the resultant increases in propeller size and speed and airplane speed. The conventional splined propeller shaft and cone arrangement which worked so well on reciprocating engines up to 3000 or

4000 hp is not considered satisfactory for projected turboprops in the 8000–18,000 rated hp range.

The panel working on the new recommendation was formed to do the job at the request of the Engine and Propeller Technical Committees of the Aircraft Industries Association. The AIA committees have several times lent extensive assistance on design policy questions at the request of the SAE panel.

The panel is a joint subgroup of Committees E-21 and P-6. (Committee E-21 is the Standard Components for Aircraft Engines Committee of the SAE Aeronautics Committee's Engine Division. Committee P-6 is the Propeller Standards Committee of the Propeller Division.)

W. E. Diefenderfer of Hamilton Standard is chairman of the panel. M. E. Cushman of Curtiss-Wright Propeller Division, D. R. Pearl of Hamilton Standard, V. W. Peterson of Allison, N. F. Rooke of Pratt & Whitney Aircraft, E. A. Scordato of Wright Aeronautical, R. F. Schwarzwalder of Wright Aeronautical, and G. R. Taylor of Aeroproducts are members of the panel.

CRC News Notes

EQUIPMENT SURVEY: The 1952 CRC (Coordinating Research Council) equipment survey will focus on two items in particular: (1) getting data on part-throttle knock, and (2) finding a mechanism for evaluating customer driving habits. Twenty-six labs are participating in this survey. A report on the 1951 survey, covering 450 cars, will be available soon.

★ ★ ★

RAILROAD TESTS: Results of the first series of full-scale field service tests have been gathered This is part of a study of the effect of variations in sulfur content and ignition quality of diesel fuels on engine performance. The results are being reviewed by the railroads, engine builders, and oil companies. Tests will be made on the Chicago and Northwestern and Pennsylvania Railroads using Alco and Baldwin freight power, respectively.

★ ★ ★

STORAGE STABILITY: What's the effect of high temperatures on storage stability of various type fuels? To get the answer, over 500 fuel samples—including diesel, turbine, aviation, and motor fuels—have been stored at the Ordnance Depot at Yuma, Arizona. The samples will be kept in storage for two years and will be analyzed at regular intervals. To be studied will be storage stability, handling methods, deposits in induction manifolds and carburetors, and similar items.

★ ★ ★

DEPOSITS: A project has been started at the Navy's request. It's the study of what happens in using high-sulfur fuels in large diesel engines for propelling submarines, when using snorkel equipment. Part two of this investigation will involve work on these same problems in smaller engines.

NO SQUEEZE FROM TURBINE FUEL: Last year both the automotive and petroleum industries felt that increasing needs for aviation gas turbine fuel might affect diesel fuel for railroad and high-speed automotive diesels. But according to the Petroleum Administration for Defense, this isn't as serious as first anticipated. So CRC work on this problem has been dropped.

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DIESEL BOMB: The Bureau of Mines, Bartlesville, Oklahoma, has used a diesel bomb to investigate the effect of fuel composition and operational and equipment variables on combustion behavior. The data submitted indicate that a reproducible research tool has been developed, which will give valuable information on combustion behavior of diesel fuels Current tests are intended to demonstrate usefulness of the bomb to both the automotive and petroleum industries.

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TURBINE FUELS RESEARCH: At the request of the Air Force, CRC is arranging for an investigation of fundamental volatility characteristics of a wide range of aviation gas turbine fuels. The program is to be carried out in one of the large universities equipped to handle such work. It is anticipated that in these tests, temperatures will range up to 450 F and pressures up to 200 psi. The data developed should help in design of future fuel systems.

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MILITARY VEHICLES: A CRC test team is cooperating with the Ordnance Corps in running additional tests at the Ordnance Climatic Test Center, Yuma, Arizona. Aim of the tests is to determine the vapor locking characteristics of a series of military vehicles operating on gasoline meeting the military specification.

★ ★ ★

AIRFRAME LUBES: Several CRC panels are working on mutual adaptation of airframe lubricants and equipment. Lots of data have been secured on the high temperature operation and rust prevention phases. Information on service requirements also is being obtained. A New York National Guard unit currently is running tests on rust preventive greases. Tests to investigate the incidence of fretting corrosion are being run in helicopter rotor heads at Wright Air Development Center. A preliminary study of dry lubricants also has been added to the program. The work is being done at Air Force request.

★ ★ ★

PISTON ENGINE LUBES: The military services and industry are cooperating in an extensive study of the use of compounded lubricants in reciprocating aircraft engines. Laboratory engine data are being gotten on a number of compounded lube oil which the Air Force is running in flight service tests and which also are being run in multicylinder stand tests. Full-scale data, now being made available, should show whether any of the laboratory techniques will predict service performance adequately.

★ ★ ★

COLD WEATHER LUBES: With very minor exceptions, use of special-type Ordnance arctic lubricants has improved performance of military vehicles under extreme cold weather conditions. That's what a recent review of a considerable amount of test data showed.

About

CARL H. MUELLER has been appointed director of engineering for Lincoln Engineering Co. He was formerly assistant to the president in charge of product development, and is also a director of the company. Mueller has been with Lincoln since 1934.

M. P. DeBLUMENTHAL has been named chief research engineer of the Studebaker Corp., South Bend, Ind. Previously assistant chief research engineer, deBlumenthal has been with Studebaker for 17 years. During World War II, he served with the Army's anti-aircraft artillery in England, France, Belgium, Holland and Germany.

B. J. GARNETT has been appointed assistant chief engineer, airborne equipment, for G. M. Giannini and Co., Pasadena, Calif. For the past ten years, Garnett has been in charge of design of aircraft and missile components for Vard, Inc., of Pasadena.

EUGENE V. IVANSO has been named director of metallurgical engineering and research for Detroit Testing Laboratories, President **DOUGLAS DOW** has announced. Ivanso has previously been associated with Bundy Tubing Co., Wyandotte Chemicals Corp., Steel Sales Corp., and most recently with the CO_2 Development Co.

JAMES J. BARRETT has been named sales manager of Gemmer Mfg. Co., Detroit. Barrett was previously Detroit representative of Bishop and Babcock Mfg. Co., Cleveland. He had been with Bishop and Babcock for more than 15 years.

DR. MAURICE J. DAY has been named manager of the materials and processes division of Armour Research Foundation of Illinois Institute of Technology, Chicago. A metallurgical engineer, Dr. Day has been with U. S. Steel Co., Pittsburgh, Pa., since 1937. As manager of the materials and processes division at Armour Foundation, he replaces **W. A. CASLER**, who has been acting manager of the division for the past year and a half. Casler continues as assistant director of research and manager of program development.

HARLEY F. COPP has been appointed chief product engineer of Ford Motor Co.'s newly-created special product operations department, according to an announcement by **WILLIAM C. FORD**, manager of the department. Copp was previously supervisory research engineer for the company.

DR. JOHN R. BATES has been named to the newly-created post of technical advisor to the executive committee of Sun Oil Co.'s board of directors. Bates' former responsibilities as director of Sun's research and development department have been transferred to **DR. J. BENNETT HILL**, director of chemical and engineering research. Bates has resigned from Sun's board of directors, but will continue to serve on the military fuels technical advisory committee of the Petroleum Administration for Defense.

RICHARD A. GREST has been named president of the Fahrney Oil Co., Houston, Texas. He was previously with Richard A. Grest and Associates in Oklahoma City, Okla.

MICHAEL J. DUDAS has been named coordinator of automotive specialists, central district, for National Carbon Division of Union Carbide and Carbon Corp., with headquarters in Chicago. Dudas was previously an automotive specialist for Ford Motor Co. in Edgewater, N. J., and prior to that was at Ford's experimental engine laboratory at Dearborn, Mich.

Members

GEORGE M. BUNN has left his post of trucking coordinator for Food Fair Stores, Inc., Philadelphia, Pa., to open a consulting service in the field of design, operation and maintenance of motor trucks, trailers and equipment. The new firm, George M. Bunn and Associates, will be temporarily located at 832 Woodbrook Lane, Norristown, Pa.

WILLIAM A. TRAUT has been named chief engineer of the F. J. Fink Co., Cleveland, Ohio. Traut was previously chief industrial engineer for Blackhawk Mfg. Co., Milwaukee, Wis.

JOSEPH L. VARGA is now general manager of Ladish Co. of Canada, Ltd., in Brantford, Ont. Varga was previously with Ladish Co. in Cudahy, Wis.

EDWIN A. DESMOND has been promoted to head a new section of the technical service division of Ethyl Corp. The section will be concerned with diesel engines, diesel fuels and diesel fuel additives. Desmond joined Ethyl as a student engineer in 1939, and has been with the company continuously except for service with the Navy submarine service during World War II.

GEORGE E. GREGG is now associate research engineer for Boeing Airplane Co. in Wichita, Kans. Gregg was previously wiring engineer with Chrysler Corp.'s Central Engineering electrical division.

ROLAND J. WOLFE is now a copilot for Hawaiian Airlines Co., Honolulu, T. H. He was formerly with Southwest Airways Co. in San Francisco as a flight purser.

A. LINCOLN PITTINGER is now president of Lincoln Engineering Co., Sierra Madre, Calif. The new consulting firm specializes in the fields of ordnance, mechanical and industrial engineering, and especially in explosives engineering. Pittinger was previously vice-president of Harold R. Swanton, Inc., in Los Angeles.

L. K. MARSHALL, manager of defense production operations of Ford's Lincoln-Mercury Division, has announced the appointment of **E. D. WILLIAMS** as manager of the quality control department of the gas turbine plant. Williams was formerly manager of Lincoln-Mercury's manufacturing engineering department.

RAYMOND E. DUNN, who was resident engineer at GMC's Chevrolet-Toledo Division, has been transferred to Detroit as assistant to the staff engineer, production engineering group, at the Chevrolet central office.

CHARLES F. KETTERING of General Motors and **PAUL G. HOFFMAN** of the Ford Foundation were featured speakers at the 50th anniversary celebration of the American Automobile Association held in Washington, D. C., Sept. 23-25.

PROF. PAUL M. STAFFORD, who was formerly associate professor of mechanical engineering at McGill University, Montreal, is now head of the department of general engineering at South Dakota School of Mines and Technology, Rapid City, S. D.

DAVID E. PARKER is now an industrial specialist for the Small Defense Plants Administration in Dallas, Texas. Parker was previously chief of the general engineering section at the U. S. Signal Corps' engineering laboratories, Fort Monmouth, N. J.

FLOYD C. MELBY has been named manager of the molded and extruded division of Goodyear Tire and Rubber Co. at the St. Mary's, Ohio, plant. Melby has been with Goodyear since 1949 at St. Mary's and, more recently, as automotive products representative in Detroit.

H. J. ROBINSON, who was manager of tractor manufacturing for Ford Motor Co., has retired from Ford. He left Detroit in late August for an extended tour. Robinson has been serving as a member of SAE's Production Activity Committee.

Lockheed Promotes

Monesmith

Hibbard

ROBERT E. GROSS, president of Lockheed Aircraft Corp., Burbank, Calif., has announced new assignments for several SAE members at Lockheed. **BURT C. MONESMITH**, recently promoted from manufacturing manager to vice-president in charge of manufacturing (see SAE Journal, August, 1952, p. 84), has been named vice-president and general manager of the California division. **HALL L. HIBBARD**, vice-president in charge of engineering, has been added to Lockheed's management policy committee. **CARL B. SQUIER**, vice-president in charge of sales, will also serve as assistant to the president.

J. B. WASSALL, former chief project engineer, becomes assistant chief engineer.

S. B. INGERSON has moved to Bartlesville, Okla., as lube planning and development engineer for the refining department of Phillips Petroleum Co. Ingerson was previously general supervisor of Phillips' compound plant in Kansas City, Kans.

WALTER F. BENNING, who recently completed a year in Europe as consultant to the Mutual Security Agency, is now on his way home to Allentown, Pa.—the long way around. Sending in his check for dues early from Zurich, Switzerland, Benning explains that it may be difficult to forward mail to him, since his itinerary includes the Egyptian pyramids; Kruger National Park in South Africa; Darjeeling, India; and Indonesia, Australia, New Zealand and the Fiji Islands.

JOHN A. BUGGE has joined Lock Thread Corp., Detroit. Bugge was formerly application engineer for Rosan, Inc., South Gate, Calif.

JOAQUIN A. SAAVEDRA is now a first lieutenant in the U. S. Air Force, stationed at Wright-Patterson Air Force Base as a project engineer on experimental aircraft. Lieutenant Saavedra received his master's degree in aeronautical engineering from Purdue University in June, under the U.S.A.F. officer education program.

New Assignments at Pratt and Whitney Aircraft

Smith—to assist engineering manager

Pratt—new chief engineer

Beardsley—heads atomic energy project

ARTHUR E. SMITH, chief engineer of Pratt and Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn., has been promoted to assistant to **WRIGHT A. PARKINS**, engineering manager. Succeeding Smith as chief engineer is **PERRY W. PRATT**, who was formerly assistant chief engineer. **GUY E. BEARDSLEY, JR.**, development engineer, has been placed in charge of Pratt and Whitney's atomic energy project. **ROSS H. BEGG** has been named development engineer in charge of the entire J-57 Turbo-Wasp project, and **DONALD J. JORDAN** becomes development engineer in charge of an advanced jet project.

EARL W. WINANS is now director of product engineering for Federal Motor Truck Co., Detroit. Winans, an SAE member since 1908, has been chief engineer of Federal since 1932.

BERNARD E. RICKS has been named general manager of the new suspension plant of Thompson Products, Inc., at Fruitport, Mich. Ricks has been assistant chief engineer of the Michigan plant for the past nine years.

N. S. CHADHA, chief engineer of Chhitar Mal Ram Dayal Mills, Punjab, India, is currently in London to pursue advanced studies in refrigeration engineering at the National College of Heating, Ventilating, Refrigeration and Fan Engineering.

THOMAS H. WICKENDEN, vice-president in charge of development and research of the International Nickel Co., Inc., has been elected a member of the Welding Research Council of the Engineering Foundation.

CHARLES F. KETTERING, director and research consultant of General Motors Corp., was one of four engineering leaders awarded honorary civil engineering degrees by Rennselaer Polytechnic Institute at a ceremony on August 20 which commemorated the Institute's graduation exercise 100 years ago, when the first degrees in civil engineering awarded in this country were presented to four RPI graduates.

GEORGE J. DASHEFSKY has been promoted to superintending engineer of the materials laboratory at the U. S. Naval Shipyard in Brooklyn, N. Y. Dashefsky was formerly head of the laboratory's mechanics division.

GENE L. BUCKMAN is now secretary of the Greater Vancouver Retail Fuel Dealers Association in Vancouver, B. C. Buckman was formerly secretary-manager of the Automotive Transport Association of British Columbia, with headquarters in Vancouver.

ROBERT H. YEAKEY is now a road and engine test engineer for Southwest Research Institute, San Antonio, Texas. Yeakey was formerly with International Harvester Co. in Fort Wayne, Ind.

RALPH K. REYNOLDS, formerly assistant professor of mechanical engineering at Washington State College, is now product designer for International Harvester Co., Melrose Park, Ill.

VINCENT G. POLOVKAS, who was previously assistant professor in the department of aeronautical engineering of the University of Florida, has joined Consolidated Vultee Aircraft Co., Fort Worth, Texas, as a structures engineer.

CARLTON A. RASMUSSEN is now in Detroit on special assignment for Cadillac Motor Car Division of GMC. Rasmussen was previously at the Cadillac Cleveland Tank Plant as staff engineer on drive and suspension.

EDWARD N. COLE, new chief engineer of GMC's Chevrolet Motor Division, was recently awarded his degree and a Ten-Year Key Award from General Motors Institute, Flint, Mich. The Key Award is made to alumni of the Institute who have reached positions of executive responsibility or equivalent technical responsibility in the corporation within ten years of leaving the Institute. The belated diploma was voted to Cole when it was discovered that in December, 1932, when nearing the completion of his studies at GMI, Cole was called back to a full-time job at Cadillac Motor Division at the request of **JOHN F. GORDON**, then chief engineer of Cadillac, who reported "an urgent need for his services." This year the Board of Regents of GMI unanimously agreed that Cole's experience since leaving school has given him more knowledge than would be required for the missing credits.

JOHN E. NELSON is now with Harold R. Swanton, Inc., Pasadena, Calif., as project engineer. Nelson was previously chief design engineer for the Ahlberg Bearing Co., Chicago, Ill.

T. A. CAMPOBASSO, who was previously with Pan American World Airways in Frankfurt, Germany, has joined Alaska Airlines, Seattle, Wash., as director of maintenance and engineering.

JOHN O. KOBZINA, JR. is now technical advisor to Spencer Auto Electric Co., Tampa, Fla., engaged chiefly in conducting an educational program on automotive equipment service and sales. Kobzina was previously with the Army's Detroit Arsenal, stationed at International Harvester Co., Melrose Park, Ill.

MARION L. SMITH and **K. W. STINSON** of Ohio State University are authors of a new textbook that provides fundamental and factual information on solid, liquid, and gaseous fuels, and the problems associated with their combustion. The authors have written this book because they feel that the general treatment of fuels and combustion is often slighted in engineering curricula, although the combustion process is a vital link in power cycles. It is published by McGraw-Hill, New York City.

Miller and Worth Get New Titles at Cummins

J. C. MILLER (left) has been promoted to executive engineer in charge of all product engineering and research activities with the engineering department of Cummins Engine Co., Inc., Columbus, Ind. Miller has been manager of research and refinement for Cummins since joining the company in 1947. **D. B. WORTH** (right) has been named manager of field quality for Cummins. He was previously manager of product engineering.

CONRAD J. ORLOFF, who was formerly project engineer for GMC's Chevrolet Aviation Engine Division, Buffalo, N. Y., is now with the engineering department of the Chevrolet Flint Manufacturing Division, Flint, Mich.

THOMAS WOLFE, president of Pacific Airmotive Corp., recently announced that his company has a new multi - compartment, high - altitude chamber with fingertip control. This device will be used to test cabin pressure regulators and safety valves manufactured by PAC. The device can be adjusted to within 0.01 psi by the chamber operator by simply turning a knob or flipping a switch. Wolfe says the chamber will also be used in the company's research and development work, and to test its pneumatic and electrical valves.

T. R. SLOCUM, JR., is now with the Commercial Casting Co., Los Angeles, Calif., as aircraft test design engineer. At present, he is on assignment in St. Charles, Mo. Slocum was previously aircraft design engineer for Mayer Engineering Co., Los Angeles.

FREDERICK C. FOSHAG is now senior mechanical engineer for Aro, Inc., St. Louis, Mo. He was previously with Marquardt Aircraft Co., Van Nuys, Calif., as facilities unit supervisor.

LLOYD H. MULIT has been named manager of economic planning for the California Oil Co., Barber, N. J. Mulit was previously assistant to the chairman of the company.

J. A. RADFORD is now with the Sperry Gyroscope Co. in Middlesex, England, as technical assistant on research and development. Radford was formerly technical assistant for Bryce Fuel Injection, Ltd.

WALTER S. TAYLOR, who was formerly a draftsman for U. S. Steel Co. in Pittsburgh, Pa., has joined the Columbus, Ohio, division of North American Aviation, Inc.

JOSEPH J. DeFREES is president and owner of the new Allegheny Valve Co., Warren, Pa. Before forming the new company, DeFrees was vice-president and chief engineer of the Pennsylvania Furnace and Iron Co.

Oldsmobile uses high-speed camera in tests

H. N. METZEL, chief engineer of GMC's Oldsmobile Division, recently announced the use of an ultra high-speed motion picture camera in tests of the valve mechanism of the high compression "Rocket" engine. The camera has been operated at a speed of 15,000 frames per second to record valve action while the engine runs at 4400 rpm. Here **F. G. BUTLER**, (left), Oldsmobile senior design engineer, adjusts timing of the stroboscopic light, while Robert Mooney, project engineer, governs engine speed and Richard O. Painter of GM Proving Ground operates the camera.

Promoted at Ethyl Corp.

C. F. Naylor

C. FRED NAYLOR (left) has been promoted to the new post of manager of personnel development in the sales department of Ethyl Corp. He will be responsible for the recruiting and selection of sales personnel and coordination of Ethyl's various sales training programs. Naylor will be succeeded as assistant regional manager, western region, by **MONROE F. WEILL**, who has been district manager at Ethyl's Los Angeles offices.

M. F. Weill

KEITH J. RENISH is now research engineer for the Bucyrus-Erie Co., South Milwaukee, Wis. Renish previously held the same title with Bostrom Mfg. Co. in Milwaukee.

ALEXANDER A. ZWIERZCHOWSKI, formerly instructor of mechanical engineering at the University of Bridgeport, Conn., has joined the Babcock and Wilcox Co., New York City, as a draftsman in the propositition and contract division.

D. T. SAUNDERS is now vice-president and director of studies of Tractor Training Service, Portland, Ore.

B. D. NEWMAN has joined the new firm of Barber-Greene Canada, Ltd., Toronto, Ont. Newman was previously project engineer for the Dominion Rubber Co. in Montreal, Que.

RICHARD C. AYLWARD has been promoted to manager of the Chicago office of Bohn Aluminum and Brass Corp. Aylward was previously sales engineer for Bohn in Detroit.

DONALD F. SUPPES has joined Aero Engineering, Inc., Mineola, N. Y., as a field engineer. He was formerly sales engineer for Files Steam Specialty Co., Boston, Mass.

JOHN P. HOBART, who was at the Chevrolet-Aviation Division of GMC, has been transferred to the engineering department of Chevrolet Motor Division in Detroit.

EDWARD A. BRASS has joined Wright Aeronautical Division of Curtiss-Wright Corp., Wood-Ridge, N.J., as senior test engineer. He was previously test engineer for Continental Aviation and Engineering Corp. in Detroit.

NORMAN E. DANIELSON is now field service representative for GMC's Allison Division, Indianapolis, Ind. Danielson was formerly production control engineer for American Airlines in Tulsa, Okla.

JOHN J. DEVLIN, who was previously design engineer for Bethlehem Steel Co., Bethlehem, Pa., is now in San Diego, Calif., as design engineer for Solar Aircraft Co.

RICHARD E. JAMES, who was previously assistant professor of mechanical engineering and assistant engineer in the physical science laboratory at New Mexico College of Agriculture and Mechanical Arts, is now with the Texas Electric Service Co. at the Permian Basin Plant, Monahans, Texas.

Obituaries

WILLIAM S. BOWMAN

William S. Bowman, chief of the field engineering section of the automotive laboratory at Aberdeen Proving Ground, died August 28 after a long illness. He was 34.

A native of Hartford County, Md., Bowman entered government service as an automotive test and repair apprentice at the Proving Ground in 1939, after attending the University of Maryland. He was engaged in the work of the automotive laboratory during most of his career, and played a constructive part in improving the equipment and procedures used in field tests of Ordnance vehicles.

He is survived by his wife and three sons.

ALBERT LODGE

Albert Lodge, president and treasurer of Lodge Petroleum Corp., died August 3 following a heart attack. Lodge, who was 71, was treasurer of SAE's New England Section for more than 20 years.

Born in England, Lodge came to the United States at the age of 7. Beginning his career as an automotive engineer in 1906, he lived and worked in New York City and Boston before settling in Greenfield, Mass., in 1928. He operated a Chevrolet agency in Greenfield for some years before entering the petroleum field.

Lodge was a past president and director of the Kiwanis in Greenfield, and was attending a committee meeting when he was stricken with the heart attack. He was also a member of the Masons and of the Greenfield Country Club.

He is survived by his wife and a brother.

HARRY H. HOOKER

Harry H. Hooker, 58, died suddenly on August 4. He was assistant chief engineer of the Eaton Mfg. Co., Cleveland, Ohio.

Hooker was vice-president of SAE representing truck and bus activity in 1951, and was currently a member of the Truck and Bus Activity Committee. He was also a past secretary and treasurer of Cleveland Section.

Born in Monongahela, Pa., Hooker joined the Herron-Webb Engineering Co. in Monongahela at the age of 18, as a draftsman, and was later put in charge of axle design for the Liggett Spring and Mfg. Co. He went to Cleveland in 1918 to work on axle design for Standard Parts Co., and joined Eaton Mfg. Co. four years later. He was appointed assistant chief engineer in 1924.

Hooker was a member of the Cleveland Chamber of Commerce, the Mid-Day Club and the Euclid Kiwanis Club in addition to his activities for SAE.

HUBERT K. DALTON

Hubert K. Dalton, 86, died July 26 in Honolulu, Hawaii, his home since 1941. Dalton had been an SAE member since 1908.

Dalton was born in London, England. Coming to the United States at an early age, he was brought up and educated in Cleveland, Ohio. After an apprenticeship in the machine tool industry, he worked on the design and mechanics of the original Chevrolet car. This was followed by the development of the Dalton Tool Corp. and the rehabilitation of the Armstrong Products Corp. of Huntington, W. Va., of which he was president at the time of his death.

Among Dalton's hobbies was an interest in orchid growing, which later developed into a business enterprise. He was active in civic and philanthropic activities in Honolulu.

Dalton is survived by his wife.

NEWS OF SAE

pages 91—99

SAE Goes TV in '53 . . .

. . . as Truck & Bus Activity schedules an in-the-flesh video program on new Timken lab for Annual Meeting.

CHALK up a first in technical meeting techniques for SAE's 1953 Annual Meeting. Television will make its debut as an integral part of the Society's meetings when L. W. Fischer, vice-president of Timken-Detroit Axle, reveals for the first time the company's new Alden Indoor Proving Ground.

The live television presentation, sponsored by the SAE Truck & Bus Activity, will be made at the evening session on Monday, Jan. 12.

Varied Features Planned

"Larry" Fischer reports that fairly extensive plans are being made for this unique program. Built around Fischer's paper on Timken's new test lab facility will be a video show presented over a theatre-size television screen. First the present laboratory methods of testing rear axles will be discussed and demonstrated. Next the audience will see on the TV screen a motion picture of proving ground operations at Camp Bullis, where Army vehicles are tested by the Ordnance Department.

In the third part of the program, the audience will be taken into the Timken plant, via television, to see the first public demonstration of the new equipment. TV will also play an important part in the discussion period. Members of the audience at the SAE session will be able to ask questions of engineers and technicians at the Timken plant. Respondents at the plant will be seen and heard on the video screen. TV cameras at the session itself will bring the question-askers' queries and pictures to the technical personnel at the plant.

Fischer advises that participants in the program will include members of the Timken staff, Ordnance men, and General Electric engineers. (GE played a big part in building the new test facility.) In addition, scores of TV technicians will be planning and working behind the scenes to put over this program.

The American Medical Association used TV this year in demonstrating an operating technique at its convention. The SAE video program is believed to be the first use of the medium for a meeting of a professional engineering group. While the AMA TV program was televised over a national hookup and could be picked up over standard receivers by the general public, the SAE program will be televised over a closed circuit.

Lawrence W. Fischer, vice-president of Timken-Detroit Axle Co., will supplement his paper on the new Alden Indoor Proving Ground with a live television show of this test lab

Indoor Proving Ground

Just as exciting as the TV aspect of this program is the subject of the meeting, the Alden Indoor Proving Ground. Named in memory of the late Col. H. W. Alden, a Past-President of SAE, the lab is built around an electronically-operated dynamometer for testing axles. It works something like this:

A tape recording is taken of the loadings on the axle on a truck operated over a given stretch of road. This tape then is fed into the dynamometer at the lab, which in turn puts a test axle through the same paces as the axle on the truck operated over the highway. So if Timken wants to see how an axle will hold up under a given set of operating conditions, it just feeds into the dynamometer a tape that represents that type of operation. So a good deal of tedious, time-taking field testing (often hampered by inclement weather), can be replaced by the new indoor proving ground technique.

ATOMIC . . .

. . . energy's industrial role to be forecast by Detroit-Edison president.

MODERN miracles will be worked by industry with atomic energy, argue some. Others say it's pretty much a military weapon, with some possible, but impracticable, powerplant possibilities. Perhaps the real answer lies somewheres midway between these two extremes.

The Production Activity's meetings vice chairman, L. I. Woolson, promises a realistic look at atomic energy at the 1953 SAE Annual Meeting in Detroit next January. He reports that a man steeped in the subject and one with the industrial slant will give SAE an insight into the possibilities and problems with atomic energy. He is Walker L. Cisler, president of the Detroit-Edison Co.

Cisler has rubbed shoulders with atomic energy in more than one way.

For example, his company has been studying jointly with Dow Chemical the feasibility of using a nuclear reactor to generate electric power. He has served as a consultant to the Atomic Energy Commission.

Cisler rose to the top of his company via the engineering route. He embarked on his career armed with a degree in mechanical engineering from Cornell University. His first job was with the Public Service Electric and Gas Co. of New Jersey, and he's been with the public utility industry ever since.

PLASTICS . . .

. . . reinforced for use in car bodies to be expounded at Annual Meeting.

ENGINEERS who want to find out all about reinforced plastic car bodies and other automotive items made from this new material should plan to attend the Body Activity's session Tuesday afternoon, January 13. The session, at which J. W. Greig of Woodall Industries will be chairman, is to be part of the SAE Annual Meeting to be held January 12-16 at the Sheraton-Cadillac Hotel in Detroit.

There engineers will hear from Dr. Games Slayter how embedding plastics with reinforcing materials such as glass fiber gives them a higher strength-weight ratio than even steel. Dr. Slayter is Owens-Corning Fiberglas's vice-president in charge of research and development and has been a pioneer in the field of reinforced plastics.

He and other speakers will give data on the toughness and dimensional stability that the reinforcements can add to the plastics' inherent weather-resistance, easy moldability, and colorability. These are some of the characteristics that make the new material of particular interest for sports car bodies.

Several of the more experienced fabricators of plastic sport car bodies will be on hand to describe their production operations, Greig expects. He is working with R. A. Terry of Creative Industries and G. M. Buehrig of Ford of the Body Activity Committee on plans for the session.

The plans allot a considerable part of the afternoon to a discussion of the place of reinforced plastics in the automotive industry by a panel of materials suppliers, plastics fabricators, and established automobile manufacturers. To supplement the talks and discussion, there will be an exhibit of automotive products made experimentally from reinforced plastics.

Sports car bodies made, like these, from reinforced plastics will be the subject of the Passenger Car Body Activity's session on Tuesday afternoon, January 13, during the SAE Annual Meeting. The vibrin plastic-glass fiber body shown here weighs approximately 185 lb. Its average thickness is 0.2 in. Translucent body at left shows shadows of two men supporting it. Bodies can also be impregnated with coloring matter or painted

Brass for '53 Aero Meeting and Production Forum in New York

Rudolph F. Gagg, president of Air Associates, Inc., is general chairman of the 1953 SAE Aeronautic Meeting, New York, April 21-23

Roy T. Hurley, president of Curtiss-Wright Corp., is sponsor of the SAE 1953 Aeronautic Production Forum, New York, April 20

Dr. Michael Field, partner of Metcut Research Associates, is general chairman of the SAE 1953 Aeronautic Production Forum

HUGE FORGES . . .

. . . and extrusion presses will be subject of symposium arranged by 4 societies.

PLANS for design, construction, and operation of huge new presses for forging and extruding light metals will be revealed in an all-day symposium December 2 at the Hotel Statler in New York.

This will be the first open meeting of engineers interested in airframe construction to discuss the industry-wide heavy press program. The program has been set up cooperatively by industry and government to insure that the United States will have the

William O'Donnell

equipment to mass produce large, thick wing skins and other big forgings and extrusions that modern airframes require. The new forges and presses planned are expected to provide production capacity and quality of product that could not be realized in time of national emergency by machine tools alone.

Papers tentatively scheduled include:

"Requirements for Large (Light Metal) Forgings and Extrusions in the Aircraft Industry," by George W. Papen of Lockheed Aircraft.

"The Design and Construction of Large Forging and Extrusion Presses for Light Metals," by Dr. Morris Stone of the United Engineering and Foundry Co.

"Metallurgy and Production of Suitable Light Metal Ingots for Large Forgings and Extrusions," by Thomas L. Fritzlen of Reynolds Metals.

"The Large Forging Press Operation and Its Production Problems," by George Motherwell of Wyman-Gordon Co.

"The Large Extrusion Press and Its Production Problems" by T. F. McCormick of the Aluminum Co. of America.

SAE is one of four technical societies co-sponsoring the meeting. The others are the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, and the Institute of the Aeronautical Sciences. The meeting will be held as part of the annual meeting of the ASME.

On the committee arranging the symposium are Robert B. Lea of the Sperry Corp.; J. Carlton Ward, Jr.; and Dr. George Gerard of New York University. SAE's representative is Dr. William O'Donnell of Republic Aviation. Other technical society representatives are: ASME, O. B. Schier, II; AIME, Dr. T. A. Read; and IAS, Robert Dexter. Major John F. Probst has been assigned by the U. S. Air Force as liaison officer to the symposium.

AIR CARGO . . .

. . . and air logistics to be topic at all-day meeting December 1 in New York City.

FOUR societies are planning the fourth annual Air Cargo Day for December 1 at New York's Hotel Statler around the propositions that

- It takes a huge air supply system to back up modern fighting forces.
- A healthy commercial air cargo industry is one of the best guarantees of a strong wartime military air transport.
- Efficient terminal equipment is a must to preserve the speed advantage of air shipment and minimize non-flying costs.
- Military vehicles, oil-field equipment for foreign use and other large machinery likely to be shipped by air should be designed from the start with the idea of its air transportability in mind.

The sponsors of Air Cargo Day are the Aviation and Materials Handling Divisions of the American Society of Mechanical Engineers, the Institute of the Aeronautical Sciences, the Air Cargo Task Committee of the National Security Industrial Association, and the SAE. Air Cargo Day will be part of ASME's annual meeting being held December 1-5 in New York.

The morning session will feature a panel on "Air Cargo Terminal Requirements." The afternoon session will be devoted to a three-paper symposium on "International Air Cargo Trends." In the evening three military men and the president of a commercial air freight operator will discuss "Air Transportability."

L. R. "Mike" Hackney of Lockheed Aircraft will be chairman of Air Cargo Day, and Carl D. Brell of Seaboard & Western Airlines will be vice-chairman.

Chairman of this year's Air Cargo Day is L. R. "Mike" Hackney (left) of Lockheed Aircraft. He is shown here looking over a model of a modern air freight terminal with Gordon Stanton of Lockheed Air Terminal

LONG TIME . . .

. . . SAE membership to be recognized by framed certificates.

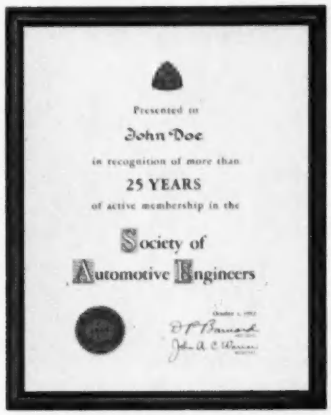
SAE Council recently developed a token of recognition for members who have been active in the Society for 25 years or more. Within the next few months, framed certificates (such as the one shown above) will be received by 1260 SAE'ers in appreciation of their long-time membership. That's about 7½% of the total SAE membership.

There are 335 members who have been active in the Society more than 35 years. They will receive gold-illuminated certificates. The 925 members who have been active in SAE between 25 and 35 years will be awarded silver-illuminated certificates.

The certificates will be presented through SAE Sections, in many cases at their meetings. Members residing outside of Section territory who have earned certificates will receive theirs directly from SAE President D. P. Barnard.

This is a continuing program. As members reach the 25 and 35 year marks, they will receive certificates.

In preparing the award, Council had the cooperation of the Executive Committee of the SAE Membership Committee. This certificate award is the second step taken toward recognizing long-time membership. Last year the presentation of gold and silver membership cards was started.



CALENDAR

National Meetings

Meeting	Date	Hotel
	1952	
TRANSPORTATION	Oct. 22-24	William Penn, Pittsburgh
DIESEL ENGINE	Oct. 30-31	Chase, St. Louis, Mo.
FUELS and LUBRICANTS	Nov. 6-7	The Mayo, Tulsa
	1953	
ANNUAL MEETING and ENGINEERING DISPLAY	Jan. 12-16	The Sheraton-Cadillac, Detroit
PASSENGER CAR, BODY, and MATERIALS	March 3-5	The Sheraton-Cadillac, Detroit
PRODUCTION	March 25-27	Statler, Cleveland
AERONAUTIC and AIRCRAFT ENGINEERING DISPLAY and AIRCRAFT PRODUCTION FORUM	April 20-24	Hotel Governor Clinton, New York City
SUMMER	June 7-12	The Ambassador and Ritz Carlton, Atlantic City, N. J.
INTERNATIONAL WEST COAST	Aug. 17-19	Georgia Hotel, Vancouver, B. C.
TRACTOR and PRODUCTION FORUM	Sept. 14-17	Hotel Schroeder, Milwaukee

Good Meetings Are Made, Not Born

The successful Change Control Panel at the SAE Aircraft Production Forum early this month at Los Angeles was no accident. It grew from careful planning by interested men. Here they are at one of their sessions at Northrop Aircraft's plant. They are (left to right): Art Burton, Lockheed Aircraft; E. W. Rentz, SAE staff; N. H. Shappell, Douglas Aircraft; S. J. Worth, Northrop; Panel Leader H. E. Herdrich, Northrop; K. P. Bowen, Northrop's vice president in charge of production, sponsor of the group's luncheon; H. F. Berry, North American Aviation; D. N. McIsaac, Lockheed; F. W. Lloyd, Northrop; and A. P. Schunck, Douglas-Long Beach

Tie Clasp Added to SAE Jewelry

The new SAE tie clasp is pictured above with the SAE lapel emblem and SAE watch charm. Tie clasp and lapel emblem are gold plated. The charm is 10 kt gold. The SAE insignia comes in blue enamel for member grade, red enamel for associate member grade, and white enamel for junior member grade.

The jewelry is available through SAE headquarters, 29 West 39th St., New York 18, N. Y. Price of the tie clasp is $2.50 plus $0.50 federal tax. The clutch-back lapel emblem is $1.50 plus $0.30 federal tax. The charm is $5.00 plus $1.00 federal tax. On items sold for delivery in New York City, a 3% city sales tax is charged.

The tie clasp was approved by the executive committee of the SAE Membership Committee at the Summer Meeting last June.

ALDIP . . .

. . . coating for ferrous metals gets billing on Annual Meeting program.

STEEL mufflers coated with aluminum by GMC's new aluminum Aldip process outlast plain steel center tube mufflers several times. Just how this new dipping method works and what it can do will be spelled out at the 1953 SAE Annual Meeting, on January 12, by A. L. Boegehold, of GMC.

According to M. F. Garwood, vice-chairman for meetings of the SAE Engineering Materials Activity Committee, Boegehold and his associates will disclose the properties of the process they developed and their experience with it in pilot production.

Right now it looks as if Aldip will do at least these two big jobs:

1. Resist rust and corrosion for ferrous parts. It may also replace zinc-coated metals for some uses.

2. Serve as a heat-resistant material. It may help conserve strategic alloys now used in high-temperature applications for military equipment.

The trouble with most other aluminum hot-dipping methods, Boegehold will explain in his paper, is that they're either commercially impracticable or too costly for large-scale production. The Aldip technique is relatively inexpensive. And it can be used for coating an entire part or component where a high degree of formability is needed.

The GM researchers will reveal their experience with pilot production of several type parts at the Engineering Materials session at the Annual Meeting. Among those they will discuss are fabricated steel manifolds (being made for the GM Detroit Diesel Engine Division) and heat exchangers for an auxiliary tank motor (a job under way at the GM Harrison Radiator Division).

The heat exchanger is a fairly complicated unit. It's a miniature radiator consisting of two small tanks connected by a series of parallel tubes.

Aldip: How to Do It

Boegehold and his colleagues will detail the steps involved in the Aldip process. At Harrison Division, for example, the heat exchangers are first thoroughly cleaned. Then they're dipped in a preheated salt bath at a temperature of 1280 to 1400 F. Next step is to dip the parts in an aluminum bath for ½ to 1 min. The still hot heat exchangers go back to the salt bath. Excessive aluminum is removed by airblasting.

Big obstacle that had to be overcome in developing Aldip was finding a durable container for the salt flux and dip. Boegehold found the answer in seeing lighted Christmas candles float in a bowl of water.

Wednesday, October 22

10:00 a.m. **Urban Room**

Welcome—S. G. PAGE, General Chairman of Meeting
Chairman—O. A. BROUER, Swift and Co.
Secretary—HENRY JENNINGS, Fleet Owner

Fleet Management; A Job Evaluation
T. L. PREBLE, Tide Water Associated Oil Co.

Requirements: Satisfy management as a department head; boss the shop as an engineer; get along with vehicle manufacturers as a customer. Meanwhile, fleet managers buy, sell, maintain, and operate vehicular equipment effectively, efficiently, profitably. Or else!

(Sponsored by Transportation and Maintenance Activity)

2:00 p.m. **Urban Room**

Chairman—F. B. LAUTZENHISER, International Harvester Co.
Secretary—M. W. ENGLISH, National Highway Users Conference, Inc.

Lighter Trucks for Heavy Hauling
C. L. BURTON and E. P. WHITE, Aluminum Co. of America

Lower profits, higher taxes, and restrictive laws create growing demands for heavier payloads on lighter motor trucks. One answer is to use light metal alloys in vehicle construction.

(Sponsored by Truck and Bus Activity)

Thursday, October 23

9:30 a.m. **Urban Room**

Chairman—J. A. HARVEY, Pittsburgh Railway Co.
Secretary—W. A. HOWE, Gulf Oil Corp.

Total Control with Power Hydraulics
R. H. FRITZGES, Mack Manufacturing Corp.

Power hydraulics, applied to city buses, does virtually everything except make change! Steering, braking, controlling engine and transmission, opening and closing doors, operating windshield wipers and radiator shutters, become one-finger jobs.

(Sponsored by Truck and Bus Activity)

2:00 p.m. **Urban Room**

Chairman—J. V. BASSETT, Raybestos-Manhattan, Inc.
Secretary—R. L. SAILER, Freedom Valvoline Oil Co.

Rolling Wheels Gather No Skids
A. C. GUNSAULUS, Goodyear Aircraft Corp.

Recent tests at Pine Lake, Wisconsin, demonstrate that electrical sensing devices assure individual wheel control, preventing motor vehicle skidding and jackknifing. Movies show details of this new contribution to highway safety.

(Sponsored by Transportation and Maintenance Activity)

Dinner

Thursday, October 23

7:00 p.m. **Ballroom**

Welcome—K. G. SCANTLING
Chairman, SAE Pittsburgh Section
R. J. S. PIGOTT, Toastmaster
ROBERT CASS
1953 SAE Presidential Nominee

"American Technology—A State of Mind"
DR. WILLIAM A. GRUSE
Administrative Fellow, Mellon Institute

Friday, October 24

9:30 a.m. **Urban Room**

Chairman—LINN EDSALL, Philadelphia Electric Co.
Secretary—M. K. SIMKINS, Commercial Car Journal

Weight Reduction of Power-Driven Highway Vehicles
J. N. BAUMAN, White Motor Co.

By combining function, lightness, and economy in motor truck design, engineers are solving tough problems for operators caught between increasing transportation costs and tightening highway use restrictions.

(Sponsored by Transportation and Maintenance Activity)

2:00 p.m. **Urban Room**

Chairman—H. E. FOX, GMC Truck and Coach Division, General Motors Corp.
Secretary—W. T. MENEWISCH, GMC Truck and Coach Division, General Motors Corp.

Experimental Bench Testing Techniques for Truck and Bus Components
GIL F. RODDEWIG, GMC Truck and Coach Division, General Motors Corp.

Speed, economy, accuracy, and time-saving are among many benefits from bench-testing gauges, switches, hoses, and chassis fittings. Improvements can be evaluated without waiting for the weather.

(Sponsored by Truck and Bus Activity)

Program for

SAE

National

Transportation

Meeting

Hotel William Penn

Pittsburgh, Pa.

October 22-24, 1952

Program for

SAE National Diesel Engine Meeting

October 30-31, 1952

Chase Hotel, St. Louis, Mo.

Thursday, October 30

9:00 a.m. **Starlight Roof**

Welcome—R. O. SLATTERY,
General Chairman of Meeting

Chairman—ARTHUR HEINTZE,
Sinclair Refining Co.
Secretary—W. H. COWDERY,
Sinclair Refining Co.

Practical Use of the Spectrograph and Electron Microscope for Study of Diesel Engine Conditions
RAY McBRIAN and L. C. ATCHISON, Denver and Rio Grande Western Railroad Co.

Electron micrographs, spectrographic analysis, and study of operating conditions reveal additive-type diesel lubricating oils as colloidal suspensions. These oils cannot be mixed, base stock solvency is important, additive depletion occurs—all factors affecting performance, wear, economy.

An Electron Looks at Detergent Oils
J. L. BROUGHTEN, Union Oil Co. of California

Those inquisitive gadabouts, the electrons, are putting the finger on particles in lubricating oils, even differentiating between additives, oxidation products, and contaminants. Electron microphotographic studies may evaluate the condition of used oils.

Spectrographic Analysis Improves Diesel Engine Maintenance
H. R. SENNSTROM, American Locomotive Co.

Progress report on a continuing 18-railroad evaluation of spectroscopic analysis of diesel lubricating oils in controlling engine maintenance. Initial results suggest spectrograph is essential maintenance tool.

2:00 p.m. **Starlight Roof**

Chairman—ADAM EBINGER,
St. Louis Public Service Co.
Secretary—HARRY DECKER,
Phillips Petroleum Co.

Diesel Locomotive Bug Hunters—or How to Exterminate the Steam Locomotive
E. W. KETTERING, T. B. DILWORTH, and J. M. NORRIS, Electro-Motive Division, General Motors Corp.

Transformation of gas-electric railcars into diesel-electric locomotives has been attended by hatches of bugs and chronic headaches. Modern design elements are compared with initial railroad, marine, and stationary requirements.

Dinner

Thursday, October 30

6:30 p.m. **Starlight Roof**

NIELS C. BECK
Chairman, SAE St. Louis Section

R. R. TUCKER
Toastmaster

D. P. BARNARD
SAE President

★

"Atomic Power—Is It Necessary?"

EDWIN J. PUTZELL, JR.
Secretary, Monsanto Chemical Co.

Friday, October 31

9:00 a.m. **Starlight Roof**

Chairman—A. J. JEUDE, Nordberg Mfg. Co., Busch-Sulzer Division
Secretary—F. J. HUBER, Nordberg Mfg. Co., Busch-Sulzer Division

Combustion Studies in an Open-Chamber Diesel Engine
W. CHOW, J. H. THOMAS, O. A. UYEHARA, and P. S. MYERS, University of Wisconsin

Data obtained by a unique hot-motored pressure-time diagram suggest that the mechanism by which additives increase the cetane number may differ from the fuel characteristics which raise cetane number. Prepared discussion.

2:00 p.m. **Starlight Roof**

Chairman—L. A. WENDT,
Shell Oil Co.
Secretary—JULIAN RYAN,
Shell Oil Co.

Diesel Engines in Fork-Lift Trucks
L. C. DANIELS, Buda Co.

Fire dangers, noxious fumes, and other difficulties limiting the utilization of gasoline-powered fork-lift trucks are eliminated by diesel engines. Additional advantages include reduced costs of fuel, insurance, and maintenance.

Procedures Used in the Development of the Barnes and Reinecke Air Force Diesel Engine
E. W. SPANNHAKE, Barnes and Reinecke Co.

Specially-adapted test methods expedited development of a two-cycle, air-cooled diesel embodying a symmetrical scavenging system. A new method of increasing the penetrating power of the fuel injection spray improves combustion.

Program for

1952 SAE National Fuels & Lubricants Meeting

The Mayo, Tulsa, Okla., November 6-7

Thursday, November 6

9:00 a.m. **Crystal Ballroom**

Welcome—W. F. FORD, Chairman, SAE Mid-Continent Section
Chairman—R. C. ALDEN, Phillips Petroleum Co.
Secretary—D. B. WIMMER, Phillips Petroleum Co.

Combustion Chamber Deposition and Knock

H. J. GIBSON, C. A. HALL, and D. A. HIRSCHLER, Ethyl Corp.

Combustion chamber deposits increase antiknock requirements as rapidly as fuel is improved. Compression ratios could be upped were deposits eliminated by countering such factors as engine design, operating conditions, fuel and oil types.

Some Factors Affecting Precombustion Reactions in Engines

M. W. CORZILIUS, D. R. DIGGS, and D. L. PASTELL, E. I. du Pont de Nemours and Co., Inc.

Fuel knock is governed by chemical reactions in fuel-air mixtures. Decelerating these reactions discourages knocking. Key factors: engine speed, fuel-air ratio, fuel structure, antiknock compounds.

2:00 p.m. **Crystal Ballroom**

Chairman—N. C. PENFOLD, Southwest Research Institute
Secretary—J. W. VOLLENTINE, Caterpillar Tractor Co.

The Correlation of Lubricating Oil Engine Test Procedures

RICHARD STANSFIELD and J. G. WITHERS, Anglo-Iranian Oil Co., Ltd.

Correlation of laboratory tests and field experiments demands matching of operating variables. Test principles suggest that, with correlation of gasoline and diesel engine cleanliness, a universal test engine becomes possible.

The Development of Rust Preventive Lubricating Oils for Reciprocating Aircraft Engines

E. F. H. PENNEKAMP and J. D. OATHOUT, Esso Laboratories, Standard Oil Development Co., and D. B. McFADDEN, Humble Oil and Refining Co.

New laboratory test procedure measures rust-proofing qualities of oils, and has led to development of new lubricating oil compositions with non-metallic inhibitors. Engine tests and commercial experience confirm laboratory experiments.

Thursday, November 6

6:00-6:50 p.m. **16th Floor**

FELLOWSHIP HOUR

Sponsored by SAE Mid-Continent Section

7:00 p.m. **Crystal Ballroom**

Dinner

F. A. SUESS, Chairman

J. H. BAIRD, Toastmaster

D. P. BARNARD, SAE President

Principal Speaker to Be Announced

Friday, November 7

9:00 a.m. **Crystal Ballroom**

Chairman—J. R. SABINA, E. I. duPont de Nemours and Co., Inc.

Symposium on Synthetic Lubricants

Engineering Possibilities of Synthetic Lubricants

W. A. ZISMAN, Naval Research Laboratory

Round-up data on "tailor-made" synthetics, their properties, sources, uses, and futures. Plus experience as lubricants for instruments, bearings, electric motors, motor vehicles, and aircraft.

Diesters and the Properties Which Make Them Useful as Specialty Lubricants

V. W. WARE, Rohm and Haas Co.

Unique among liquids are the diesters, which lubricate, are non-corrosive, respond to additives. They resist freezing to 100-below, maintain viscosity. Additionally non-volatile, they have researchers excited about them as synthetic lubricants.

Performance of Turbo Engine Synthetic Oils

A. B. CRAMPTON, W. W. GLEASON, W. E. LIFSON, and E. F. H. PENNEKAMP, Esso Laboratories, Standard Oil Development Co.

Stand and flight tests in American and British turbojet and turboprop powerplants indicate that new ester-type synthetic lubricants meet extreme service demands, including low volatility, high loads, and oxidation-corrosion stability.

The Case for Synthetic Lubricants in Winter Operation of Automotive Engines

H. F. GALINDO and J. A. MILLER, Standard Oil Co. of California

How to blend synthetic with natural oils for effective winter lubrication of gasoline and diesel engines. Field and laboratory tests reveal special properties essential to cold-weather operation.

2:00 p.m. **Crystal Ballroom**

Chairman—W. F. FORD, Continental Oil Co.
Secretary—C. A. HALL, Ethyl Corp.

The Mode of Formation of Lead Deposits in Gasoline Engines

J. C. STREET, Thornton Research Center, Shell Petroleum Ltd.

Study of chemical steps in the action of scavenging agents and search for information as to lead's part in preflame reactions indicate that, at peak antiknock action, the lead compound always contains a PbO bond in the molecule.

Volatility Studies of Military Vehicles, Covering CRC-Ordnance 1951-1952 Devil's Lake Work

J. G. MOXEY, JR., Sun Oil Co., C. S. BRUCE, National Bureau of Standards, and KENNETH BOLDT, Pure Oil Co.

Detailed report of a joint Coordinating Research Council-U.S. Army Ordnance test program to ascertain cold weather starting and warm-up performance, vapor lock and volatility requirements, of current military transport and combat vehicles.

SAE Section Meetings

Cleveland Section Hears About New Diesel

• Cleveland Section

Wilson B. Fiske, Field Editor

Sept. 8—Over 400 members turned out for the dinner, plant tour and meeting at which the Cleveland Diesel Engine Division of General Motors Corp. was host to Cleveland Section. This was a closed meeting for members only and subject to security regulations. A highly successful event, it marked the auspicious start of the 1952–53 season under the leadership of Chairman Robert E. Cummings.

Members assembled at plant no. 1 of the Cleveland Diesel Engine Division for dinner in the plant cafeteria, followed by a tour of that plant where they watched machining, assembling, and testing operations on diesel engines. They then journeyed to plant no. 3, where heavy machining operations were witnessed. Here the meeting was held.

Of particular interest was the company's new 16-cylinder vertical radial diesel engine. The development of this revolutionary design was the subject of the speaker, **Eric R. Brater**, assistant chief engineer of the division. He was introduced by George W. Codrington, vice-president of General Motors and general manager of the Cleveland Diesel Engine Division, who welcomed SAE and pledged support to its activities.

With the aid of slides, Brater described the conception and design of the new 16-cylinder vertical radial diesel engine, which is the most compact engine ever designed for its horsepower, an important factor in marine application. The design has also solved many problems of installation, maintenance and accessibility.

As described, the engine has four vertical banks of four cylinders each. Wooden models were used extensively in the design of this powerplant and its component parts, and were very useful in testing and correcting. Brater observed that wooden models are expensive initially but pay huge dividends in the long run. He discussed the unusual construction of the crankcase, main bearings, connecting rods, and other important parts and described the testing procedures to determine stress concentration, torsional vibrations, operating efficiency, and so forth.

Since Cleveland Diesel Engine Division sponsored the meeting, the moderate charge made by Cleveland Section will go into the student activities fund of the Section. This year, in addition to the annual student banquet and other activities of the past, Cleveland Section is providing two scholarships for students of Fenn College and Case Institute of Technology respectively. These scholarships were explained at the meeting by Cleveland Section Vice-Chairman Ned Brown. The support of such organizations as Cleveland Diesel has made student activities possible.

Visit Plant Of Sunnen Products

• St. Louis Section

E. E. Wallace, Field Editor

Sept. 9—The first fall meeting of St. Louis Section was held at the plant of Sunnen Products Co. The 160 members and guests attending enjoyed a conducted tour through the plant while it was in operation, and followed manufacturing processes from the die casting stage to completed products.

Sunnen Products manufactures precision honing machines, crankshaft grinders, valve lifters and other tools for automotive repair shops. Principal products are Sunnen's hones, which range in size from $\frac{1}{8}$ in. diameter to large hones for use on automotive and marine cylinders.

After the tour the group was treated to an excellent lunch in the plant cafeteria. President Joseph Sunnen, who arranged the tour, personally welcomed the Section members.

Members of St. Louis Section hear Joseph Sunnen, president of Sunnen Products, following the plant tour that opened the fall meeting program on Sept. 9

New Aircraft Seen in Movies

• Williamsport Group

Paul Cervinsky, Field Editor

Sept. 10—Seventy-two members and guests inaugurated the 1952–1953 season with a buffet supper at the Antlers Club. Guests and new members were welcomed by Adam E. Sieminski,

Continued on Page 102

Clevelanders visit two plants of GMC's Cleveland Diesel Engine Division

Eric R. Brater, assistant chief engineer of Cleveland Diesel Engine Division, used slides to illustrate his talk on the company's new 16-cylinder vertical radial diesel

Cleveland Section Chairman R. E. Cummings opened the meeting and addressed the Section members briefly

George W. Codrington, vice-president of General Motors and general manager of Cleveland Diesel, welcomed SAE members to the plant

Tom Durkin, Cleveland Section transportation and maintenance chairman, told of some of the meetings planned for the new season

Members here watch assembly at Cleveland Diesel Engine Division's plant 1; later traveled to plant 3 to view heavy machining operations

The technical meeting, attended by more than 400 members, was held on the factory floor of Cleveland Diesel's plant 3

25 Years Ago

Facts and Opinions from SAE Journal of October, 1927

An advertising man recently asked J. M. Watson, of Hupp Motor Car Corp., "How many different types of SAE steel do you use?" "About ten," Watson replied. "Oh, damn," he said, "I hoped there were 40 or 50; it would make such an impression on the buying public if we could give a long list."

■

A recent development in fusion welding is arc welding in a hydrogen atmosphere, James C. Bennett, of Associated Oil Co., told members at a Northern California Section meeting. Arc welding in a hydrogen atmosphere is superior to arc welding in oxygen because embrittlement of the metal at the weld is avoided . . . and welds can be obtained that have greater ductility and tensile strength than the rest of the metal

■

One of the troublesome factors in the design of electric motors used in industrial machinery is lack of standardization of the roller bearings used. At the request of the National Electrical Manufacturers Association, the SAE Ball and Roller Bearings group is drawing up a specification for such electric-motor bearings.

■

If the progress in honing made during the next few years is comparable with that made in the recent past, it may soon be possible to assemble an engine with the initial wear eliminated from every moving part.—L. A. Becker, A. P. Schraner & Co., in Production Meeting paper.

■

A few years ago the metallurgical department was considered only an overhead expense and a novelty. It was considered something good to talk about and to show to visitors when they came to the factory. Now, however, it has risen to a recognized and secure position as a valuable adjunct to all other departments in the organization.—J. M. Watson, Hupp Motor Car Corp., in Production Meeting paper.

■

Headlights are probably the only adjunct to present stock automobiles which the public—and engineers—generally condemn as unsatisfactory. Various reasons are advanced for this. One is the complex problem of securing good road illumination without producing intolerable glare for approaching drivers. Others are the technical difficulties in making good headlight adjustments, and lack of rigidity and permanance of the headlamp equipment.—H. C. Dickinson, Bureau of Standards, in address at Headlight Session of the Semi-Annual Meeting.

■

In the near future, the internal combustion engine will undoubtedly supplant the steam engine on light-traffic lines, in yard switching service, and where fuel and water are hard to obtain. Beyond that, development and service will govern its expansion in the locomotive field. —A. H. Candee, Westinghouse Electric & Mfg. Co., in Pennsylvania Section paper.

■

The Subcommittee on Education of the Operation and Maintenance Committee has set up a program to keep fleet operators, maintenance men, and factory service managers acquainted with the latest fleet operation and maintenance methods.

The plan calls for eliciting up-to-date information from these individuals . . . correlating, sifting, and condensing tips on specific subjects, then presenting the results at Section meetings, and to Society members through the Journal.

Continued from Page 100

chairman. The supper was followed by the showing of the following films:

"The Air Force Goblin—Parasite Jet Fighter"—courtesy of McDonnell Aircraft Co.

"Planes Without Pilots"—courtesy of Bell Aircraft.

"Jet Propulsion and the Jet Story"—courtesy of General Electric Co.

"Navy Whirlaway"—courtesy of McDonnell Aircraft Company.

These films gave a glimpse of the tremendous effort being undertaken to keep America's air power and strength supreme.

Following the films the group enjoyed the colored slides shown by Secretary H. E. Epler of his trip to the Canadian Rockies and Glacier National Park.

Section Enjoys Outing, Holds Fuel-Miser Contest

• New England Section
George T. Brown, Field Editor

June 30—The annual outing of the New England Section was held at the Marlboro Country Club with over two hundred members and friends in attendance. An exhibit of old-time cars was contrasted with a lineup of the latest in 1952 models.

The truck field was also well represented. Massachusetts Bonding Insurance Co. and the Massachusetts Registry of Motor Vehicles displayed special equipment for driver testing.

Another feature was the fuel economy test. Contestants drove a special car with facilities for accurately measuring the amount of fuel consumed over a certain route. L. H. Blatchford was declared the winner with the best miles per gallon record.

Golf was increasingly popular and a large number of participants kept the course in a near-congested state. Among the winners of the various events were: Murray Brown, Jack Bocing, Al Hunt, Len Clark, Herman Jackson, John Swayze, Ken Shoven, G. MacNiel, G. Metz, N. Jackson, E. Walker, and F. Cafrey.

A steak dinner was the highlight of the evening. Harry Stanton, incoming Section chairman, officiated during the festivities and announced the winning numbers of the door and other prizes. Prizes ranged from electric blankets, radios, hats, golf bags and golf balls, to checks. Everyone received at least one prize, and there was a grand prize to boot. All of these prizes were donated by members and companies represented by members.

Barnard Barnstorms the Sections

From Boston to Vancouver, SAE President meets the Members

Northern California Section, May 15—On his visit to San Francisco, Dr. D. P. Barnard enjoyed cocktails on a sun deck overlooking the famous bay. Left to right: Morris Pomeroy, of United Airlines; Dr. Barnard; W. G. Nostrand, Section chairman for 1951-52; and Hollister Moore of SAE's New York headquarters

Syracuse Section, Feb. 18—Dr. Barnard addressed a joint meeting of the Section and the Technology Club of Syracuse. Technology Club President Mark N. Russell presided. Standing, left to right: Samuel Wolcott, Jr.; Hollister Moore; David T. Doman; Dr. Barnard; John L. Collins; and R. S. Root. Seated: Syracuse Section Chairman Carl F. B. Roth; Mark N. Russell; Charles B. Spase; and William J. During

Barnard Barnstorms . . .

British Columbia Section, May 22
Northwest Section, May 23
Spokane Intermountain Section, May 26
Oregon Section, May 19
Twin City Section, Sept. 12
Salt Lake Group, Sept. 26
Northern California Section, May 15
Colorado Group, Sept. 24
Kansas City Section, March 27
Wichita Section, March 28
Hawaii Section, Oct. 5-15
San Diego Section, Sept. 29
Texas Section, April 3
Houston Division, April 4
Western Michigan Section, March 3
Chicago Section, Feb. 12
Montreal Section, March 19
Canadian Section, March 18
Mid-Michigan Section, March 10
Syracuse Section, Feb. 18
New England Section, Feb. 8
Mohawk-Hudson Group, April 25
Southern New England Section, Feb. 7
Buffalo Section, Feb. 19
Philadelphia Section, Feb. 13
Williamsport Group, Feb. 14
Baltimore Section, Dec. 15
Washington Section, Dec. 16
Virginia Section, Dec. 17
Cleveland Section, Feb. 11
Dayton Section, Dec. 10
Cincinnati Section, Dec. 9
Indiana Section, Dec. 11
Atlanta Group, Dec. 19
D. P. Barnard spoke here
D. P. Barnard will speak here

. . . Since taking office last January, President Barnard has visited 26 Sections and Groups; will journey to eight more before Christmas. (He's in Hawaii now.)

Southern New England Section, Feb. 7—At Hartford, President Barnard shared the speaker's platform with rocket expert Willy Ley. Left to right: Willy Ley, Richard C. Molloy, and Dr. Barnard

Cleveland Section, Feb. 11—Arriving at Cleveland Airport, President Barnard skipped backward four decades of transportation when he stepped from a modern airliner into a 1913 White touring car

Wichita Section, March 28—With officials of Boeing Airplane Co. and Wichita Section, Dr. Barnard toured production lines at Boeing's Wichita division and viewed operations on the B-47 Stratojet. Left to right: Harry Soderstrom, Don Simon, Gomer Jones, Dr. Barnard, Section Chairman Virgil Hackett, Walt Burnham, Hal Dick and Ed Rentz

Mid-Michigan Section, March 10—At Lansing, Dr. Barnard sat at the "wheel" of Old Scout, the original curved-dash Oldsmobile. Left to right: R. C. Sackett, Dr. Barnard, Marshall McCuen and James Dykstra, both of Oldsmobile

Cleveland Section, Feb. 11—Cleveland Section Chairman R. I. Potter (right) proclaimed Dr. Barnard to be the "king-size man" needed for the post of SAE president and, after anointing him with SAE oil, presided over his coronation

Montreal Section, March 19—In a visit to one of SAE's three Sections in Canada, Dr. Barnard poses with Montreal Section officers. Seated, left to right: Section Chairman E. J. Cosford, Dr. Barnard, John A. C. Warner of SAE headquarters, and W. S. Cowell. Standing: R. A. Harvey, F. H. Moody, F. B. Thompson, H. L. Eberts, A. E. Jennings, and H. L. Barre

Coming Events in SAE Sections

Buffalo—Oct. 21

Hotel Sheraton, Buffalo. Dinner 6:30 p.m., meeting 8:00 p.m. Economic Relationship of Fuel Research—J. A. Stonex, Head of Technical Data Department, General Motors Proving Ground. Also a special film on the work of GM Proving Ground.

Canadian—Oct. 15

Royal York Hotel, Toronto. Dinner 7:00 p.m., meeting 8:00 p.m. Effect of Weight-Power Ratio on Highway Transportation—N. R. Brownyer, vice-president, sales and service engineering, Timken-Detroit Axle Co.

Chicago—Oct. 14

Hotel Knickerbocker, Chicago. Dinner 6:45 p.m., meeting 8:00 p.m. Light Alloys in the Car of the Future—Howard Dunn, assistant manager Development Division, Aluminum Co. of America. Social Half-Hour—6:15 p.m. to 6:45 p.m.

Cleveland—Oct. 13

Lake Shore Country Club. Dinner 6:00 p.m., meeting 7:00 p.m. Symposium — Leasing versus Company Ownership of Motor Vehicles—Howard L. Willett, Jr., president, Willett Co.; Harry O. Mathews, manager of transportation and distribution, Armour & Co.; Robert Gardner, manager automotive department, Lever Bros. Co.; E. C. Pratt, general manager, Fleet Leasing Corp.; Howard Amor, vice-president, Cleveland Cartage Co.

Colorado—Oct. 16

Petroleum Club. Meeting 8:00 p.m. Prevention of Brake Block Wear—E. L. Cody, service manager, Grizzly Mfg. Co.

Dayton—Oct. 7

Biltmore Hotel. Dinner 7:00 p.m., meeting 8:00 p.m. The Nash Healy Sports Car—Earl Munson, development engineer, Nash Kelvinator Corp. Display of the car.

Detroit—Oct. 20 and 27

Oct. 20—Rackham Educational Memorial Bldg. Meeting 8:00 p.m. Junior Group Panel Meeting. Horsepower, Plus or Minus. Emmett Horton, Ford Motor Co.; Thomas Mitzelfeld, General Motors Corp.; Harold Welch, Chrysler Corp. Consultants: Wallace Berry, Nash-Kelvinator Corp.; Nelson Farley, Kaiser-Frazer Corp.; Gale Sprague, Packard Motor Car Co. Moderator, Frank Veraldi, Ford Motor Co. Social Hour in Snack Grille following technical session.

Oct. 27 — Rackham Educational Memorial Bldg. Meeting 8:00 p.m. Panel Meeting. Torque Converters for Heavy-Duty Trucks. R. M. Schaefer, Allison Division, GMC, and W. B. Gibson, Hydraulic Division, Twin Disc Clutch Co.

Indiana—Oct. 16

Marott Hotel, Indianapolis. Social Half-Hour 6:30 p.m. Dinner 7:00 p.m., meeting 8:00 p.m. Applications of Spun Glass Products in Automotive Industry—Elmer P. Warnken, director, Cincinnati Testing and Research Laboratories.

Kansas City—Oct. 14

Rosellis, 912 Walnut, Kansas City. Topic to be announced. Ben Mills, Aircraft Division, Ford Motor Co. Social Hour 6:15 p.m.

Metropolitan—Oct. 16

Brass Rail Restaurant, New York City. Dinner 6:30 p.m., meeting 7:45 p.m. Fuels and Lubricants Meeting. M. M. Roensch, Ethyl Corp.—Moderator; J. C. Geniesse, Atlantic Refining Co.; J. F. Kunc, Standard Oil Co. Subject—Engine Wear.

Mid-Continent—Oct. 3

Oklahoma City. Topic to be announced. N. C. Penfold, assistant to the president, Southwest Research Institute.

Milwaukee—Nov. 7

Milwaukee Athletic Club. Dinner 6:30 p.m., meeting 8:00 p.m. Ice Testing of Trucks—D. G. Simonds, chief engineer, Four-Wheel Drive Co.

Mohawk-Hudson—Oct. 15

Circle Inn, Lathams, N. Y. Dinner 7:00 p.m., meeting 8:15 p.m. Engineering Problems with Commercial Air Transport—M. G. Beard, chief engineer, American Airlines, Inc. Joint meeting with American Society of Mechanical Engineers.

Northern California—Oct. 22

Engineers Club, San Francisco. Dinner 6:30 p.m., meeting 7:30 p.m. Current Problems on Motor Gasoline and Cars—Gilbert Way, technical representative, Ethyl Corp. "Old Timer's Night"—special invitation to former chairmen—issuing of 25 and 35 Year Certificates.

Northwest—Oct. 8

Hotel Stewart, Seattle, Wash. Dinner 6:30 p.m. Combustion Chamber Deposits—E. W. Malin, sales engineer, E. I. duPont de Nemours & Co., Inc.

Philadelphia—Oct. 8

Engineers Club, Philadelphia. Dinner 6:30 p.m., meeting 8:00 p.m. Atomic Power in Mobile Application, Lt.-Com. J. A. Barker, Naval Reactor Branch, Division of Reactor Development, U. S. Atomic Energy Commission.

Southern California—Oct. 16

Rodger Young Auditorium, Los Angeles. Dinner 6:30 p.m., meeting 8:00 p.m. Development and Application of the Horizontal High-Speed Diesel Engine for Automotive Installations—C. Raymond Boll, Manager, engine sales, Cummins Engine Co.

Southern New England—Oct. 7 and Nov. 5

Oct. 7—Hartford Golf Club. Dinner 6:45 p.m., meeting 8:00 p.m. Rocket Motors—Raymond W. Young, Reaction Motors, Inc.

Nov. 5—Hotel Sheraton, Springfield, Mass. Dinner 6:45 p.m., meeting 8:00 p.m. Industrial Gas Turbines—B. O. Buckland, manager of engineering, General Electric Co.

Texas—Oct. 19

Italian Village Restaurant. Dinner 6:30 p.m., meeting 8:00 p.m. Boeing Gas Turbine—S. L. Shannon, turbine project engineer, Boeing Airplane Co.

Twin-City—Oct. 8

Dinner 6:30 p.m., meeting 8:00 p.m. Minneapolis Moline Uniharvestor Design and Operation—Martin Ronning, chief engineer, Minneapolis Moline Co. Inspection of Models.

Virginia—Oct. 27

William Byrd Hotel. Dinner 7:00 p.m., meeting 8:00 p.m. Engine Rebuilding—Russell G. Riley, Thompson Products, Inc. Social Hour.

Western Michigan—Oct. 21

Sterns Steak House. Dinner 6:30 p.m., meeting 8:00 p.m. Heavy-Duty Tractor and Earthmoving Equipment.

Getting Longer Life Out of Transmissions

Based on paper by

E. J. BARTH
Spicer Mfg. Co.

and

T. BACKUS
Fuller Mfg. Co.

THE gears in a transmission for heavy-duty service have longer life than the bearings because they are less susceptible to damage caused by improper lubricant or dirt. Close fit must be maintained in bearings, therefore, dirt frequently locks the balls or rollers, causing skidding or even turning of the race in the housing and resultant quick failure. Sometimes, when a mechanic tries to spin one race relative to the other he finds the bearing rough and replaces it with a new one, thus, many bearings are discarded which would be entirely suitable for use if cleaned.

There are many types and makes of lubricants with proven qualities for use in specific locations. Although indispensible in these certain applications, many are unsuited for truck transmissions and may cause much harm due to corrosion of bearings, plugging of oil holes, hard carbon deposits, and excessive foaming. A good grade of straight mineral oil can support tooth loads adequately and concern for corrosion, separation, or other objectionable qualities is eliminated with its use.

A transmission should be drained, flushed, and refilled with clean lubricant periodically, and it should be checked frequently to see that the correct amount of lubricant is maintained. It is desirable to drain, flush and refill at low mileage or break in period to eliminate chips and dirt, just as is done with an engine. The builders of transmissions recognize dirt as a major contributor to premature wear or failure and take precautionary measures to eliminate burrs, chips, and foreign matter. Furthermore, due regard is paid to cleanliness in the design of a transmission as evidenced by shields, seals, slingers, traps, dams, magnetic drain plugs, pumps and filters.

If the operator and service men cooperate to the best of their ability to keep a transmission clean, then it can be expected to last until all the gears, shafts, and bearings have worn proportionately and there is a final and complete failure But this long life

AMERICAN CHEMICAL PAINT COMPANY
AMBLER CHEMICALS ACP PROCESSES PENNA.

Technical Service Data Sheet
Subject: PROTECTING ALUMINUM WITH ALODINE®

"ALODINE" No. 100

"Alodine" No. 100 forms an amorphous phosphate surface on aluminum which is thin, tough, durable, non-metallic, continuous with and a part of the basis metal. The "Alodine" film anchors paint, prolongs paint life, and protects aluminum exposed unpainted to the atmosphere.

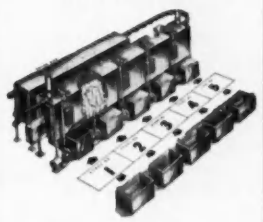
With the "Alodine" No. 100 bath at its normal temperature of 120° F., coating time by immersion approximates 1½ minutes—and by spraying, 15 to 20 seconds. Coating times and bath temperatures can be varied to suit operating conditions.

"ALODINE" No. 600

"Alodine" No. 600 forms corrosion-resistant coatings that provide excellent protection for unpainted aluminum and also make an effective paint-base. This grade is recommended for use in place of "Alodine" No. 100 on aluminum parts that are to remain unpainted or to be only partly painted; and on *all* aluminum castings and forgings whether or not these are given a paint finish.

"ALODINE" FLOW SHEETS

MULTI-STAGE POWER WASHER FOR SPRAY ALODIZING



IMMERSION TANKS FOR DIP ALODIZING

PROCESS SEQUENCE
1. Clean 2. Rinse 3. "Alodine"
4. Rinse 5. Final Rinse

NOTE: Equipment can be of mild steel throughout, except the "Alodine" stage which must be of acid-resistant material.

"Alodine" No. 600 is applied at room temperature (70° to 120° F.). Recommended coating times are 3 to 5 minutes for an immersion process and 1 to 1½ minutes for a spray process.

COATING DATA	"ALODINE" NO. 100	"ALODINE" NO. 600
COMPOSITION	Amorphous phosphate.	Amorphous mixture of metal oxides and chromates.
COLOR	Depending on alloy treated, color range is from an iridescent blue-green to a dark slate grey.	Depending on time of treatment, color range is from golden iridescent to light brown.
THICKNESS	From 0.01 to 0.08 mil. No appreciable dimensional changes occur when aluminum is Alodized.	From 0.005 to 0.01 mil. No appreciable dimensional changes occur when aluminum is Alodized.
WEIGHT	50 to 300 mgs. per square foot. Optimum: 100 to 200 mgs. per square foot.	35 to 50 mgs. per square foot.
SOLUBILITY	Insoluble in water, alcohol, solvents, etc. Insoluble in most dilute acids and alkalis. However, strong acids and alkalis which attack aluminum may penetrate the "Alodine" film and react with the underlying metal. Slightly soluble in concentrated nitric acid. Soluble in molten sodium nitrate, etc.	Insoluble in alcohol, water, solvents, etc. Soluble in strong alkalis and acids.
ELECTRICAL PROPERTIES	High dielectrical resistance.	This coating is electrically conductive. Aluminum coated with "Alodine" No. 600 can be shielded-arc welded or spot welded.
HEAT STABILITY	Unimpaired at temperatures that melt aluminum.	Unimpaired at temperatures that melt aluminum
FLEXIBILITY	Integral with and as flexible as the aluminum itself. Can withstand moderate drawn.	Integral with and as flexible as the aluminum itself. Can withstand moderate drawn.
ABRASION RESISTANCE	Approximately 90% of that provided by chromic acid anodized aluminum.	Approximately 90% of that provided by chromic acid anodized aluminum.
CORROSION RESISTANCE	Painted—superior to chromic acid anodizing. Unpainted—comparable with chromic acid anodizing. Meets MIL-C-5541 and other Government Finish Specifications.	Exceeds requirements of MIL-C-5541 and even AN-QQ-A-696a (anodic films)
PAINT BONDING	Excellent. Equal to or superior to anodizing. Meets MIL-C-5541 and other Government Finish Specifications.	Excellent. Meets MIL-C-5541 and other Government Finish Specifications.
TOXICITY	Non-toxic.	Non-toxic.
BIMETALLIC CORROSION RESISTANCE	Shows good resistance against bimetallic or galvanic corrosion.	Shows good resistance against bimetallic or galvanic corrosion.

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can be had only by such cooperation. (Paper, "Transmission Bearings for Heavy Duty Service," was presented at SAE National West Coast Meeting, San Francisco, Aug 12, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers).

Based on Discussion

E. J. Barth, co-author of the paper, answered questions from the floor as follows:

Q: What is your company's recommendation for flushing and refilling truck transmissions?

A: This depends on application. Fuller recommends draining, flushing and refilling at 10,000 miles, Spicer at 12,000 to 15,000 miles. Both agree on the need for doing this after a few thousand miles of a transmission's service in order to remove metal particles picked up by the oil.

Q: You imply a recommendation for frequent draining to eliminate dirt. This indicates the possibility of moisture accumulation. Don't you think compounded oils would eliminate corrosion better than straight mineral oils as recommended in your paper?

A: Straight mineral oils are adequate for gear tooth loads. That's the basis of our recommendation.

Q: Have you had difficulty with top mounted power takeoffs?

A: Only in applications where rotative speed was inadequate to get oil up to the bearings in the takeoff. Here we used sealed-for-life bearings, believing loads to be light and that bearings would give satisfactory life.

Q: What method of flushing is recommended?

A: Flush when hot so that oil will drain thoroughly. The main objective is to remove dirt and metal particles. If dirt still remains, use some type of solvent.

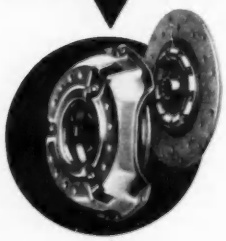
Q: What is the basis for bearing design?

A: We base on the average type of service. Designs are then checked with bearing manufacturers to obtain a reasonable life factor.

Q: What is being done to improve flywheel pocket bearing lubrication?

A: Some work of redesigning is being done, also use of sealed-for-life bearings.

This Snow "Drift Buster"



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ROCKFORD CLUTCHES

Who Complains Of Airport Noise?

Based on paper by

JAMES V. BERNARDO
Civil Aeronautics Administration

WHILE airport noise is a national problem, it has assumed its greatest proportions in the neighborhood of Greater New York. In this region, the CAA finds, the sources of complaint can be broken down into five categories. These are:

1. Residents of communities established before airport expansion got underway. They feel aviation has invaded their privacy and challenged their right to live in quiet and without fear. Many such communities have brought concerted action to get relief. People who moved into these communities after airport development took place, believing the situation to be bearable, are less belligerent and tend to seek improvement through cooperation with all concerned.

2. People who object to interference with their television reception. In this group people become chronic complainers.

3. Nearby residents who do not object to normal operation at airports,

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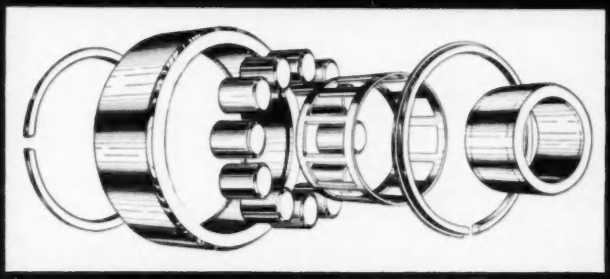

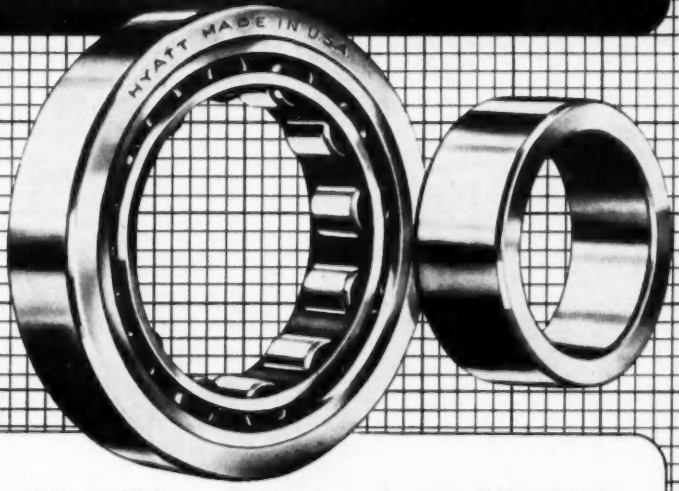

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but object to engine run-ups, particularly when they occur in the middle of the night.

4. People living 15 miles or more away from airports and settled there because they sought the quiet of country life. If they live on the approach to a runway, in some cases an instrument runway, they are disturbed when planes descend to 1500 feet.

5. Professional complainers, a relatively small group, who are not really bothered by aircraft noises, but see in the situation a chance to achieve personal ends.

Through thorough investigation of individual complaints, the CAA has been able, in many instances, to help the local situation through minor adjustments in the traffic patterns. (Paper, "Control of Aircraft Ground Noise (Symposium)", was presented at SAE National Aeronautic Meeting, New York, N. Y., April 23, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers).

Users Tell Practice In Grease Lubrication

Based on paper by

L. W. McLENNAN
and
E. AMOTT
Union Oil Co. of California

ALTHOUGH service station operators, new car dealers and fleet operators agree that chassis lubrication is effective for more than 1000 miles, they stick to this period because with frequent greasing comes the opportunity to inspect for trouble and because the gap between intended and actual lubrication is great enough as it is.

When a multipurpose grease is used for the chassis it usually replaces a NLGI 1 grade, or perhaps a softer grade. Users feel that the heavier greases lubricate more effectively for a longer distance than the softer grades. The NLGI 2 grade is harder to dispense, but by the same token, greases that are easy to dispense are readily ejected from the bearing in service by virtue of their low apparent viscosity.

Although chassis wear is not regarded as a serious problem, a few operators think king pins worthy of more study.

It is generally thought that if wheel bearings are carefully packed and installed, failures are rare. Many operators stress the need for better seals for

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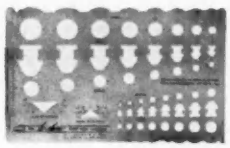

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the retention of lubricant and exclusion of dirt in wheel bearings. There is keen interest in oil lubrication of wheel bearings now practicable with effective seals. Where carefully installed on trucks and trailers they appear to be doing a good job after 75,000 to 100,000 miles of operation, or even more. There is some indication that oil lubrication eliminated fret corrosion.

Young, progressive operators were almost all in favor of one multipurpose grease in their stations. They like the reduction in number of guns, inventory, elimination of risk of mixing greases, and time saving. A few, more conservative operators prefer a number of greases for specific use. The shift to use of multipurpose greases by fleet operators and new car dealers has been gradual, but is expected to continue.

The trend is definitely toward use of not more than two greases of the more conventional type, or alternatively to the use of a single multipurpose grease. It is believed that ultimately only multipurpose greases will be used for all automotive equipment. There is also a trend toward the use of oil lubricated bearings on trucks and trailers, and within a few years the use of grease will probably be small. There is wider use of rubber on chassis points to reduce the number of lubrication points, but operators have their reservations as to how far such use can go safely. (Paper, "Simplifying Grease Lubrication for Automotive Equipment," was presented at SAE National West Coast Meeting, San Francisco, Aug. 13, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers).

Based on Discussion

J. A. Edgar
Shell Oil Co.

IN the development of a multipurpose grease, there was one application which could not be compromised: wheel bearings demanded a grease with good mechanical stability, high melting point, and resistance to oxidation, yet for general chassis use the grease had to be pumpable, and for the water pumps, insoluble. As an outcome chassis parts are to have a product higher in quality than ever used before. The work which went into solving this problem started a chain of developments having a profound effect on grease technology. New soaps have been developed which confer great mechanical stability on softer products, temperature susceptibility has been improved, oxidation inhibitors have been developed, while greater protection against water and corrosion has been gained.

While the advantages of the multipurpose greases have appealed widely to service station men and fleet owners, the really great field for application

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E. B. Ogden
Consolidated Freightways, Inc.

WE have conducted tests to see if we could extend chassis lubrication beyond the 1500 mile period. To accelerate any weakness, we selected a 5000 mile interval. We found that universal joints required servicing at more frequent intervals, regardless of mechanical condition. Our present lubrication interval is 2500 miles.

We repack wheel bearings at 70,000 to 80,000 mile intervals which are less than our present period for brake relining.

V. E. Weiss
Standard Oil Co. of California

WEISS questioned the authors as to how they regarded the acceptance of multipurpose grease by equipment manufacturers in view of current recommendations for several different type greases. The reply to this question was that in general equipment manufacturers have not yet adopted a multipurpose grease.

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Dynamometer Puts Idle Horses to Work

Based on paper by

E. L. CLINE
Clayton Mfg. Co.

THE shop has always had the responsibility for finding out what is wrong with a vehicle, overcoming the trouble, and proving the repair to have been made correctly. Now, with higher costs, it has the added burden of making anticipatory repairs. Idle horsepower cannot be tolerated; it must be put to work.

Maintenance departments must keep material and labor costs down. This means replacing only those parts which diagnosis shows necessary. They must make the correct repair the first time, and see that only vehicles adjusted for peak performance and efficiency take to the road. Hundreds of road driving conditions can be translated on the dynamometer by one or a combination of five basic operating points. These are:

1. Full throttle low speed.
2. Full throttle high speed. (Both full throttle points are equal to climbing steep road grades.)
3. High speed cruising or part throttle.
4. Low speed cruising or part throttle. (Both part throttle combinations are equal to level or near level driving.)
5. Acceleration between low and high speed points.

To take full advantage of a dynamometer, par should be set for each vehicle or group of identical vehicles. Par can be established by averaging test reports from similar vehicles. Vehicles below par should be corrected so that only fit ones go on the road. When this is done all the horses have been located and put to work.

To get the maximum use from a dynamometer the service plan should be so organized as to keep it busy on each and every shift. (Paper, "Finding Horses That Can Be Put to Work," was presented at SAE National West Coast Meeting, San Francisco, Aug. 11, 1952. It is available in full in mul-

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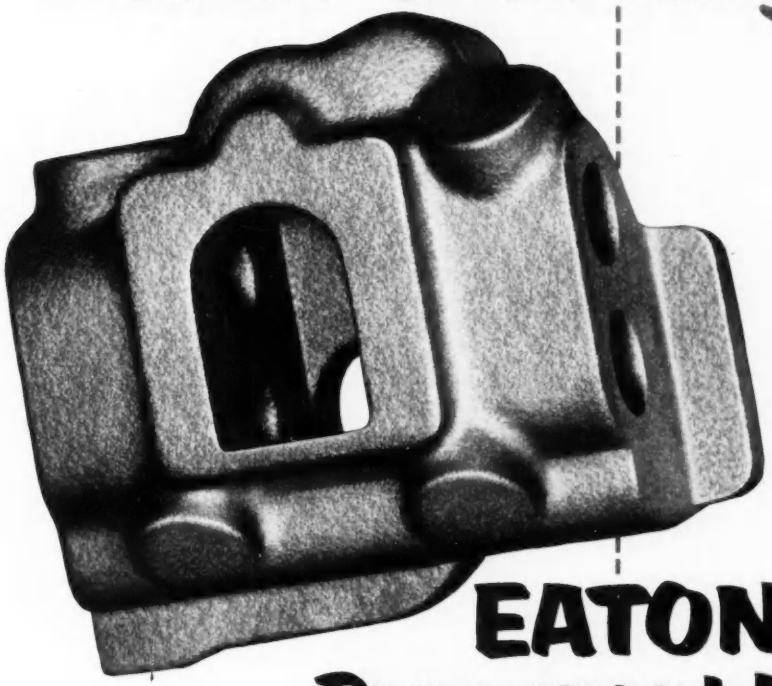

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Based on Discussion

K. E. Rush
Cummins Service and Sales

SCHEDULING of dynamometer time in any shop must be carefully controlled. Many repairs are clear cut and don't need dynamometer diagnosis. However, these ailments or complaints are dynamometer "musts":

- Power checks
- Smoke regulation
- Fuel system weaknesses
- Mechanical noises which develop under load
- Malfunction of the engine cooling system
- Leaks under load
- Lubricating oil system weaknesses

Not only does a chassis dynamometer permit fast and correct diagnosis of these ills—saving many hours of high cost labor—but it also affords the opportunity to check repair results to make certain the truck will perform properly when placed back into service. This, in turn, results in a definite reduction of customer complaints after service repairs.

Questions from floor and Cline's replies were as follows:

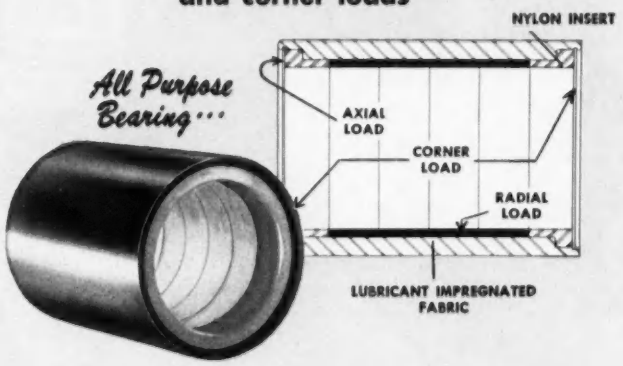
I. M. Harlow, Sr.
Tidewater Associated Oil Co.

Question: Will a chassis dynamometer located in the same room as other maintenance service facilities produce an undesirable sound level?
Answer: Location of the chassis dynamometer in any place other than the main shop cuts its efficiency considerably and hinders adequate supervision.
Question: Will excessive tire wear result from the use of a chassis dynamometer as a service tool?
Answer: Ordinarily equipment is not run on the dynamometer for long enough intervals to cause excessive tire overheating and wear. Fans can be used to cool the tires if necessary.

F. B. Lautzenhiser
International Harvester Co.

Question: Can an accelerometer be used with the same benefits as a dynamometer?
Answer: The accelerometer might take the place of the chassis dynamometer for spot checks, but no road instrument could have the flexibility or offer

. . . for combined axial, radial and corner loads



By combining the inherent characteristics of the efficient O & S lubricant impregnated bearing material and the recently developed nylon bearing material we have found the answer to the problem of simultaneously combined radial, axial and corner loading.

If you have a problem that involves all three—write for Bulletin 153.

NeverOil · SINCE 1915 ·

O & S BEARING CO.
303 SOUTH LIVERNOIS • DETROIT 17, MICHIGAN

the service possibilities of a chassis dynamometer.

A. G. Mulkey
Waukesha Motor Co.

Question: Can a chassis dynamometer be used effectively with multiple-axle-drive equipment?
Answer: A regular dynamometer with one set of rolls can be used if all driving axles except one can be locked out with a lockout bar divider. If this is not practical, it is necessary to install additional rollers for each driving axle. Such rollers are available.

F. W. Bond
Suburban Transportation System, Seattle

Question: Is a chassis dynamometer necessary in maintaining a fleet equipped with torque converter transmissions?
Answer: The torque converter might take the place of a chassis dynamometer to some degree. It is quite limited to the power range it can handle, however, since the power produced is proportional to the cube of the engine speed. Therefore, a chassis dynamometer is beneficial and needed to adequately check the entire power range.

LABORATORY TESTS PROVE:

Pure, Untreated Cotton Can NEVER Affect Additives in Oil!

EACH TEST TUBE
contains a metal rod, immersed in oil taken from the same crankcase. Tube 2 also contains long-strand cotton. Tube 1 does not.
1. Notice how acids, present in used crankcase oil, have corroded the metal rod.
2. Metal rod is good as new. Proof of cotton's neutralizing action at work.
1
2
LABORATORY REPORT
TYPES of ADDITIVES TESTED
EFFECT OF COTTON ON ADDITIVE ?
None

Laboratory tests made to determine the effect of cotton on additive-treated (heavy-duty) motor oils show that cotton is inactive on additives. Cotton actually helps these oils to lubricate BETTER, by neutralizing acids, taking out harmful impurities, and absorbing water, the cause of most acid and sludge-formation. Genuine DeLuxe Cartridges utilize PURE, UNTREATED COTTON...long-stranded and specially-wound by an exclusive process. Send for FREE catalog and informative book, "Key to Clean Lubrication". DeLuxe Products Corp., 1413 Lake Street, LaPorte, Indiana.

DELUXE HEAVY DUTY SERVICE **Oil Filters**

Wanted: Better Engine Air Filters

Based on paper by

RICHARD E. BROWN
Air-Maze Corp.

THE art of designing air filters has lagged and existing types flaunt far too many engineering compromises.

The oil wetted type is almost a menace. Although the initial pressure drop is low, pressure rise and efficiency fall-off are too rapid. The latter are assumed to be kept within tolerable limits by proper cleaning, but the assumption is dangerous and can lead to rapid engine wear from airborne impurities.

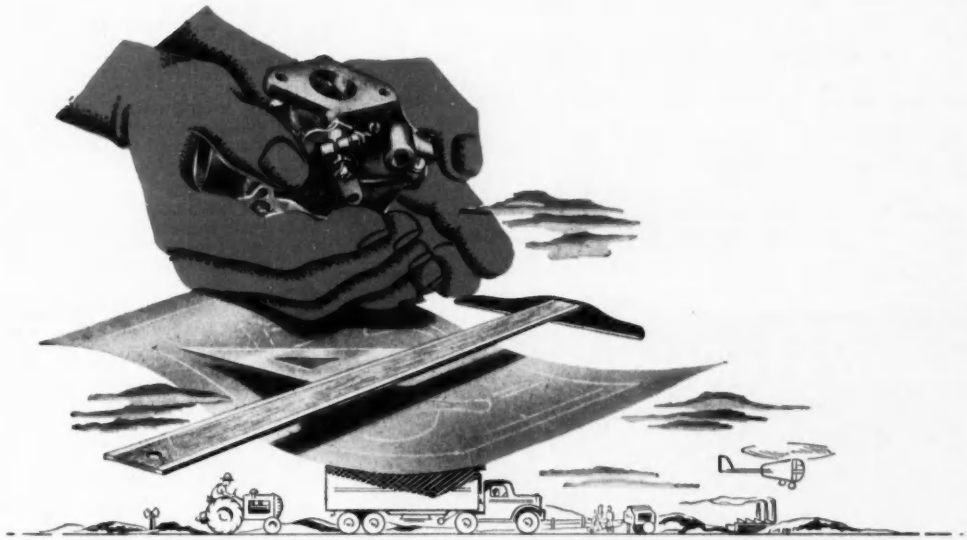
The oil bath type, although it has the fewest compromises, has too high an initial pressure drop. It weighs and costs too much, takes up too much space, and sometimes must be installed outside the engine compartment. It's messy and often difficult to service.

The centrifugal separator or cyclone has too high an initial pressure drop and the efficiency varies over too wide a range as the engine intake air flow varies from idle speed to full load speed. Space requirements make it suitable only for stationary installations. It's cost is excessive.

The strainer type of filter is the most efficient, but proper cleaning is almost impossible. The initial pressure drop is low, while the pressure rise is rapid, due to efficiency. It takes too much space and its cost rises with its efficiency.

Electrostatic filters are too expensive, too big, too difficult to service. They have too many parts to give trouble-free service and they have to be cleaned too often.

But the outlook for filters isn't wholly black. The possibilities yet to be investigated are: self-charging electrostatic plastics with possible automatic washing, high efficiency centrifuging with external energy source, or, ultra-sonic agglomeration of particles. (Paper, "Wanted—A Better Engine Air Intake Filter," was presented at SAE National West Coast Meeting, San Francisco, Aug. 13, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)



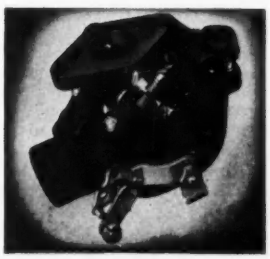
Look to field application engineering to increase your engine performance

For many years, in many diversified markets, Marvel-Schebler has concentrated on designing and adapting carbureters to meet individual requirements.

In order to satisfy all kinds of load demands, in all kinds of weather, Marvel-Schebler has relied on performance data supplied by field application engineering to help engine manufacturers obtain carbureters of proper design and calibration.

This has resulted in a constantly expanding wealth of experience in carbureters and carburetion for a wide range of applications. In the farm field alone, where rugged strength and unusual dependability provide that extra margin of economy in operation, 6 out of 10 farm tractors are using Marvel-Schebler carbureters as original equipment.

This experience can be of great help to you in the proper selection of standard equipment from the Marvel-Schebler line or in any of your carburetion problems. It is yours for the asking.



MARVEL-SCHEBLER PRODUCTS DIV.

Borg-Warner Corp., Decatur, Ill.

B-W

MARVEL-SCHEBLER *Carbureters*

Students Enter Industry

GORDON L. KNUDSON (University of Illinois '51) is in training with GMC's Electro-Motive Division, LaGrange, Ill.

W. DANIEL GRUPP (University of Colorado '51) is with Buffalo Marine Mart, Buffalo, N. Y., as project engineer.

EDWARD KACHMAN (University of Detroit '51) is a junior engineer for McCord Corp., Detroit.

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On giant diesel locomotives . . . one of the toughest of all radiator applications as far as space limitations, power concentration, and vibration characteristics are concerned . . . you'll find Yates-American radiators specified as the radiators that can take rough going, and like it! So whatever your products . . . if you require the best in radiators, write today for complete information and descriptive literature on Yates-American radiators for all purposes.

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BRANCH OFFICES: CHICAGO, ILLINOIS; HIGH POINT, NORTH CAROLINA; MEMPHIS, TENNESSEE; PORTLAND, OREGON

GEORGE J. KOLE (Aeronautical University '51) is a liaison engineer with the aircraft division of Fairchild Aircraft Corp., Parkridge, Ill.

EUGENE E. WHIGHAM (San Diego State College '51) has joined Consolidated Vultee Aircraft Corp., San Diego, Calif., as flight test engineer.

FRED J. GROSS, JR. (Rensselaer Polytechnic Institute '51) is a production engineering aide with Kaman Aircraft Corp. at Bradley Field, Conn.

RICHARD BRUSS (Valparaiso University '51) has joined the design department of Nordberg Mfg. Co., Milwaukee, Wis.

HERBERT K. C. KOP (California State Polytechnic Institute '51) is a mechanical engineer at Pearl Harbor Naval Shipyard, Oahu, T. H.

LEO A. WACK (Indiana Technical College '50) is with GMC's Aero products Division, Vandalia, Ohio.

HENRY J. KOWALCZYK (Wayne University '51) is an engineering draftsman on piping for Detroit Edison Co.

ROBERT L. JENKINS (Wayne University '51) is a second lieutenant in the U.S. Air Force, stationed at Wright-Patterson Air Force Base, Dayton, Ohio.

JOHN PATERSON (Wayne University '51) has joined Harry Ferguson, Inc., in Detroit.

DAVID M. LAIRD (Purdue University '51) is with Catalytic Construction Co., Philadelphia, Pa., as coordination engineer.

ALBERT E. SCHOENHEIT (Lawrence Institute of Technology '51) is an aerodynamicist for North American Aviation, Inc., Los Angeles, Calif.

SYLVESTER J. KOHEL (Lawrence Institute of Technology '51) is now with the engine division of Kaiser-Frazer Corp., Detroit.

WILLIAM H. GLIDDEN (Michigan College of Mining and Technology '51) is a development engineer on unconventional powerplants for Goodyear Aircraft Corp., Akron, Ohio.

J. WILLIAM SCHWEIKER (Rensselaer Polytechnic Institute '51) is in training at Watervliet Arsenal, Watervliet, N. Y.

Continued on Page 120

Koppers manufactures piston rings in every size, of every type, for every industrial and aircraft purpose.

FROM everywhere in industry come reports of outstanding performance through the use of Koppers American Hammered Piston Rings in aircraft, diesel and steam engines and other industrial equipment. That's because Koppers research and engineering keep up with modern advances in equipment design by constantly improving piston ring materials and manufacturing methods.

Koppers K-Iron Rings are made of a high-grade, closely-controlled material that imparts improved wear properties and is surface treated chemically as an anti-scuffing aid. They are made in diameters to 120" in a variety of joint types. Koppers Porous Chrome* Rings hold and distribute oil during break-in, quickly wear to best possible seating...*cut cylinder wear up to 50%, last 4 times as long as ordinary rings!*

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Students Enter Industry
Continued

JOHN F. KOWINSKI (University of Massachusetts '51) is in training with Westinghouse Electric Corp., Pittsburgh, Pa.

JOHN J. JARVIE (University of Michigan '51) is a detailer-draftsman for Ford Motor Co., Dearborn, Mich.

GARMON D. SIMMONS (Northrop Aeronautical Institute '50) is with Northrop Aircraft, Inc., Hawthorne, Calif., as liaison process analyst.

IRWIN S. JACOBSON (Illinois Institute '51) is a junior engineer in the guided missile group of Bendix Aviation Corp., Mishawaka, Ind.

DONALD KRUP (Illinois Institute of Technology '51) is a development engineer working on jet engines for Hotpoint, Inc., Chicago.

ALBERT L. HUNT, JR. (Purdue University '51) is in training with GMC's Allison Division, Indianapolis, Ind.

LEONARD J. DIPERI (Parks College '52) is with Lockheed Aircraft Corp., Burbank, Calif., as junior aeronautical engineer.

ROBERT E. SAYERS (University of Notre Dame '50) received his degree as master of automotive engineering from Chrysler Institute in June and is now a development engineer for Chrysler.

DONALD W. HOUSER (Oregon State College '50) recived his master's degree from Oregon State in 1951 and is now a research engineer for California Research Corp., Richmond, Calif.

RICHARD G. HALL (Michigan College of Mining and Technology '52) is a mechanical engineer for the Navy Department's Bureau of Ships, Washington, D. C.

IRWIN T. HARRIS (Case Institute of Technology '50) received his master's degree in business administration from Harvard University last spring, and has joined Jack and Heintz, Inc., Cleveland, Ohio.

GEORGE G. GORANSON (Purdue University '52) is a project engineer at the jet propulsion laboratory of California Institute of Technology, Pasadena, Calif.

Continued on Page 122

Top production teams back up Boeing engineers

When Boeing engineers developed the revolutionary, flexible-wing B-47, their designs called for aluminum forgings larger than any ever before made, and for a completely new kind of wing "skin" ranging in thickness from 5/8" at the body joint to 3/16" at the tip.

New techniques, machines and procedures had to be worked out. Production is so precise that the eight-ton wing slips into place with less than a hairsbreadth of clearance. Many of these new procedures were thought "impossible" a few years ago. Today they are routine in Boeing plants. That's the kind of production teamwork Boeing engineers expect—and get.

Boeing engineers also enjoy the advantages of the finest research facilities in the industry. Their work, over the past 35 years, has given them tremendous prestige. You can share that prestige by becoming a Boeing engineer. You'll work on such long-range projects as guided missiles, nuclear-powered aircraft and the exploration of supersonic flight.

There are openings at Boeing right now for experienced and junior engineers in all fields, for aircraft

- **DESIGN**
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also for servo-mechanism and electronics designers and analysts, and for physicists and mathematicians with advanced degrees.

You can choose our Midwest plant at Wichita, or work in the Pacific Northwest at Seattle. Boeing provides a generous moving and travel allowance, offers you special training, a salary that grows with you—and a future of almost limitless range.

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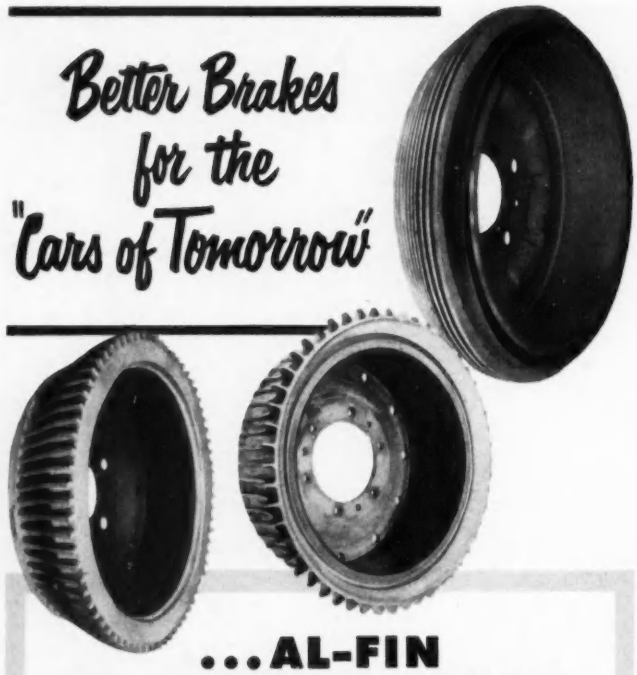

...AL-FIN BI-METALLIC DRUMS

While American Manufacturers are testing their "cars of tomorrow," the "brakes of tomorrow" are already here. Al-Fin drums have proved themselves in the most spectacular of *all* tests—the great international road races of Europe and America!

Last year, cars equipped with Al-Fin brake drums took 83 first, 48 second and 38 third places in races that ranged from the grueling 24-hour grind at Le Mans (France) to the mountainous Rallye des Alps. This year, six out of the first ten cars at Le Mans, including the first four, were Al-Fin equipped. After the race, Daimler-Benz, makers of the winning and second place cars, pronounced the Al-Fin brake drums "still in flawless condition."

Already standard equipment on certain foreign makes of cars, Al-Fin bi-metallic brake drums are the solution to the severe braking problems posed by increased speeds and horsepowers combined with torque converter transmissions on American cars.

Al-Fin is the patented molecular bonding process used to bond a cast iron friction surface to an aluminum housing that carries the torque and dissipates heat. Write for the new Al-Fin Technical Booklet illustrating brakes and other bonded bi-metallic products: pistons, sleeve bearings and bushings, timing gears, engine housings, etc.

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ENGINE AND AIRPLANE CORPORATION

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FARMINGDALE, L.I., N.Y.

Students Enter Industry

Continued

JOHN T. ELY (Utah State Agricultural College '52) is serving as a second lieutenant in the Ordnance Corps at Aberdeen Proving Ground, Aberdeen, Md.

HENRY A. CLUTZ (California Institute of Technology '52) is with Chance Vought Aircraft Division of United Aircraft Corp. in Dallas, Texas, as a junior engineer.

RICHARD L. TILLSON (Northrop Aeronautical Institute '52) is an aerodynamicist for North American Aviation, Inc., Los Angeles, Calif.

RUSSELL H. THOMAS (Georgia Institute of Technology '52) is now a design engineer for Food Machinery and Chemical Corp., Riverside, Calif.

GILBERT M. STONEBARGER (West Coast University '51) is an electronics laboratory technician for the guided missiles division of Consolidated Vultee Aircraft Co., Pomona, Calif.

GEORGE W. STETSON (Massachusetts Institute of Technology '52) is a second lieutenant in the Corps of Engineers at Fort Devens, Mass.

JAMES D. SHEPHERD (Northrop Aeronautical Institute '52) is a structures engineer for McDonnell Aircraft Corp., St. Louis, Mo.

HOWARD C. SHAW, JR. (University of Cincinnati '52) has joined Chicago Screw Co., Bellwood, Ill.

ROBERT E. RODMAN (University of Washington '49) received his master's degree in mechanical engineering from California Institute of Technology last June and is now a design engineer for the engineering department of Standard Oil Co. of California, San Francisco.

WILLIAM G. AGNEW (Purdue University) received his doctor's degree from Purdue last spring and has joined the research laboratories of General Motors Corp.

PAUL G. RACICOT (University of Detroit '52) has joined Bohn Aluminum and Brass Corp., Adrian, Mich., as a forge engineer.

HAROLD D. PORTER (Northrop Aeronautical Institute '52) is now with Fletcher Aviation Corp., Pasadena, Calif.

Continued on Page 124

Engineered Steering for Trucks

FORE-AFT AND CROSS STEER
Steering Gear Ahead of Axle

FORE-AFT AND CROSS STEER
with Intermediate Bellcrank

STEERING LINKAGE must be developed to meet the requirements of many different truck designs. Thompson's "Steering Engineers" have worked closely with truck builders for over 35 years to improve steering.

With the accent on easy steering, design advances, road speed and increased loads on the suspension and linkage; steering linkage units are required to provide more strength and accuracy and greater freedom of movement at the sockets.

Improvements in modern trucks—with many additional requirements set up by the manufacturer for military and other "off-the-road" vehicles such as four-wheel steer, etc., as well as standard commercial models—necessitated better and far more complicated steering units.

Illustrated are 2 of the types of steering linkage found on current-model trucks. The Detroit Division of Thompson Products has many other variations of steering units designed for truck use. We welcome the opportunity of submitting them for your examination. Please contact us.

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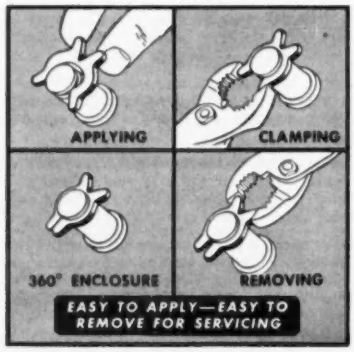

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Students Enter Industry
Continued

HAROLD D. RITCHIE (Bradley University '52) is a trainee with Richards-Wilcox Mfg. Co., Aurora, Ill.

THOMAS C. CAMPBELL (Purdue University '52) is a test engineer at GMC's Allison Division, Speedway, Ind.

ALLAN C. BURTON (California Institute of Technology '52) is a junior engineer and draftsman for Northrop Aircraft, Inc., Hawthorne, Calif.

JAMES W. LOVELAND (Cornell University '52) has joined Eastman Kodak Co., Rochester, N. Y., as a time study engineer.

BERNARD W. HILTON (University of Illinois '52) is a junior staff engineer for Aluminum Co. of America in Davenport, Iowa.

JOHN C. HUEBNER (Michigan State College '52) has joined Curtiss-Wright Corp., Caldwell, N. J.

GEORGE J. GENOTTI (Academy of Aeronautics '52) has joined North American Aviation, Inc., in Columbus, Ohio, as a flight line maintenance mechanic.

MELL D. CASSIDY (California Institute of Technology '52) is now on the staff of California Institute of Technology, Pasadena, as a research assistant.

DANIEL H. PALKOWSKI (University of Massachusetts '52) is a maintenance engineer for Carbide and Carbon Chemical Corp. at Oak Ridge, Tenn.

GEORGE V. POKORNY (University of Wisconsin '52) has joined Allis-Chalmers Mfg. Co., Milwaukee, Wis., as application engineer in the water conditioning section of the power department.

JAMES M. RAY (Oregon State College '52) is now with Westinghouse Electric Corp., East Pittsburgh, Pa.

NELSON H. BULLARD, JR. (Southern Methodist University '52) is in training with the Babcock and Wilcox Co., New York City.

RONALD C. HARRIS (Michigan College of Mining and Technology '52) is now a second lieutenant in the U. S.

Students Enter Industry

Continued

Air Force stationed at Wright-Patterson Air Force Base, Dayton, Ohio.

JOHN A. HRINSIN (Parks College '52) is now with Lockheed Aircraft Corp., Burbank, Calif., as junior engineer.

REX A. McCORMICK, JR. (Bradley University '52) has joined North American Aviation, Inc., Los Angeles, Calif., as a junior engineer and draftsman.

DOMENIO A. MAZZOLA (Bradley University '52) is now plant production engineer for General Cable Corp., Bayonne, N. J.

DONALD J. BREWSTER (Oregon State College '52) is a second lieutenant in the Air Force stationed at Brooks Air Force Base, Texas.

WILLIAM C. GREEN (Michigan College of Mining and Technology '52) has joined International Harvester, Fort Wayne, Ind., as a student engineer.

RONALD Y. YOSHIDA (Massachusetts Institute of Technology '52) is an engineering aide in the mechanical design section of Marquardt Aircraft Co., Van Nuys, Calif.

DONALD G. WALLACE (Purdue University '52) is with Perfect Circle Corp., Hagerstown, Ind.

REUBEN D. TYE, JR. (University of Tulsa '52) is a junior engineer on flight test analysis for Chance Vought Division of United Aircraft Corp., Dallas, Texas.

MAURI KURKI-SUONIO (Massachusetts Institute of Technology '52) is in Helsinki, Finland, as service manager for Autola Oy.

RALPH C. STAHMAN (Massachusetts Institute of Technology '52) is a research engineer for Ethyl Corp.'s research laboratories, Detroit.

RALPH E. MOTTIN (Purdue University '52) is with Goodyear Tire and Rubber Co., Akron, Ohio, as a junior design engineer.

JOHN J. DAVIS (Parks College '52) is now a field service engineer for Westinghouse Electric Corp., South Philadelphia, Pa.

MALCOLM B. SWIMLEY (Northrop Aeronautical Institute '52) has joined United Air Lines, Inc., Los Angeles, as a co-pilot.

BERNARD S. TABISH (Aeronautical University '52) is now an aeronautical engineer for Goodyear Aircraft Corp., Akron, Ohio.

Continued on Page 126

PIERCE-built...
Emergency Fuel Regulator for Turbo-jet engine
Aircraft Fuel Distributor for Turbo-jet engine
Main Fuel Regulator for Turbo-jet engine
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Your inquiry will receive immediate attention. Write to Chief Production Engineer,

The PIERCE GOVERNOR CO., Inc., Box 1000, Anderson, Indiana

"World's Most Experienced Governor Manufacturer"

Students Enter Industry

Continued

KENNETH R. LAIRD (University of British Columbia '52) is a technical assistant for the nylon division of Canadian Industries, Ltd., Kingston, Ont.

RICHARD K. KEPPLE (Pennsylvania State College '52) is now in training with the Research Laboratories Division of General Motors Corp., Detroit.

JOHN B. TAYLOR (Purdue University) received his master's degree from Purdue last spring and is now a lieutenant in the Air Force at Wright-Patterson Base, Dayton, Ohio.

JEROME C. VAVEREK (University of Detroit '52) is with the Civil Service Co., Patuxent River, Md., as a mechanical engineer.

WARD B. WAHL (Missouri School of Mines '52) is an application engineer for the Elliott Co., Jeannette, Pa.

WILLIAM E. MONTVILLE (Tri-State College '52) has joined the Allen D. Cardwell Co., Plainville, Conn., as development engineer.

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CHICAGO 38, ILLINOIS

RICHARD E. EDWARDS (Michigan State College '52) is a project engineer, experimental, at the engineering center of Ford Motor Co., Dearborn, Mich., while studying for a master's degree at the night school of Wayne University.

DONALD A. MALOHN (Tri-State College '52) has joined Studebaker Corp., South Bend, Ind., as a jet engine calculator.

DALE R. JOHNSON (University of Wisconsin '52) is a mechanical engineer for General Motors Corp. at the Proving Grounds at Milford, Mich.

JERRY C. RUSSELL, JR. (Northrop Aeronautical Institute '52) is with Northrop Aircraft, Inc., Hawthorne, Calif., as engineering draftsman.

STUART SORENSON (California State Polytechnic College '52) is a project engineer for Owens Illinois Glass Co. in San Jose, Calif.

ARUN PRASAD (Massachusetts Institute of Technology '52) is with General Electric Co., Schenectady, N. Y., as a gas turbine test engineer.

JAMES P. MORLEY (University of Illinois '52) is a design engineer for Chicago Rawhide Mfg. Co.

ROGER I. BUCHANAN (University of New Hampshire '52) is with the National Advisory Committee for Aeronautics at Langley Field, Va., as a junior engineer.

BERNARD JOHNSON (Michigan State College '52) has received his master's degree in mechanical engineering from Michigan State and has joined International Harvester Co., Melrose Park, Ill., as development engineer.

LAWRENCE E. PALATNIK (Academy of Aeronautics '51) is an instructor in electrical engineering at the Casey Jones School of Aeronautics of Republic Aviation Corp. at Farmingdale, N. Y.

HERBERT R. AU (Academy of Aeronautics '52) has joined Trans World Airlines at Idlewild Airport, N. Y.

ROBERT V. EBELING (California State Polytechnic College '52) is a junior civil engineer for the San Diego, Calif., Water Department.

GEORGE A. FISHER (Case Institute of Technology '52) is with Euclid Road Machinery Co., Cleveland, Ohio, as a supervisory trainee.

ROBERT R. REIMER (University of Wisconsin '52) is now plant engineer for Morris Bean and Co., Yellow Springs, Ohio.

KENNETH W. RIX (Purdue University '52) has joined Beech Aircraft Corp., Wichita, Kans., as design and development engineer.

New Members Qualified

These applicants qualified for admission to the Society between Aug. 10, 1952 and Sept. 10, 1952. Grades of membership are: (M) Member; (A) Associate; (J) Junior; (SM) Service Member; (FM) Foreign Member.

Atlanta Group

William G. Jones (A).

Baltimore Section

Paul A. Jennings (M), William Kaplan (M).

Canadian Section

J. B. Dickey (M), Leonard Horace Edwards (A), John Roland Gregory (J), James Alexander MacRae (J), Roger Rowland Watkins (M).

Central Illinois Section

Harry Bowen (M), Donald D. Henderer (J), Raymond Edward Holthe (J), Norman K. Lammers (J), William B. Norick (J), Julian V. Sanders (J).

Chicago Section

Frank N. Adgate (M), Arthur C. Allen (M), Max I. Beard (M), John L. Coursey (M), David W. Dawson (J), John H. Eby, Jr. (M), Harry A. Erickson (M), Jay H. Forrester (M), Edward Howe (J), Erwin J. Janicke (M), Alvin G. Johnson (M), Leland C. Kidd (M), Sherman R. Oblad (M), John E. Sandmeyer (M), C. Dale Schultz (A), J. M. Snell (M), Edward George Wicklatz (M).

Cincinnati Section

Richard Joseph Donovan (J), Raymond O. Hahn (A).

Cleveland Section

Richard W. Adamson (J), Harold C. Andrus (M), Erik G. Beckman (M), Henry J. Chanon (A), Harold O. Flynn (M), Edward R. Fryer (M), James F. Harding (M), James M. Herendeen (M), Robert A. Maynard (M), Victor A. Punzar (A), Anthony James Sajovec (M), Joseph F. Smole (A), John Stirling (M), Standish M. York (M), Charles H. Young, Jr. (A), Joseph A. Young (A).

Colorado Group

B. I. Noble (M), Gardner W. Turman (M).

Dayton Section

Harry L. Benjamin (M), William H. Brown (J), Charles Peyton Martin (J).

Detroit Section

Lee L. Anderson (M), George Benya (M), Carl E. Bergen (A), E. R. Carolin (A), David Leigh Cliff (M), J. R. Coffron (M), Roy Deming (M), Anderson Duggar, Jr. (J), Howard Robert Field (M), John Fleck (J), Carl L. Goodzeit (J), Thomas J. Griffen (J), A. John Karvonen (A), John J. Kelley (M), Ernst F. Klessig (M), Roman J. Kozlowske (M), Clarence R. Krisher (M), Raymond Robert Love (M), Roy William Nagle, Jr. (J), Jack W. Palmer (A), Lynn Rudy Paul (M), Edwin S. Peszynski (M), Lawrence A. Roberts (M), Richard A. Rousos (J), Edward K. Torossian (J), Leon J. Verhaeghe (M), Sven O. Wahamaki (M), James G. Weaver (SM), Richard L. Webber (A), Fred G. Whittington (M), Robert K. Williams (M).

Hawaii Section

Roger William Hume (M), A. C. William Ireton (J).

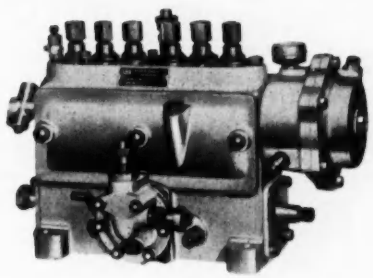
Indiana Section

Arthur C. Cocagne (M), Marion B. Emig (M), Stanley Goldstein (J), Norman B. Johnston (J).

Continued on Page 128

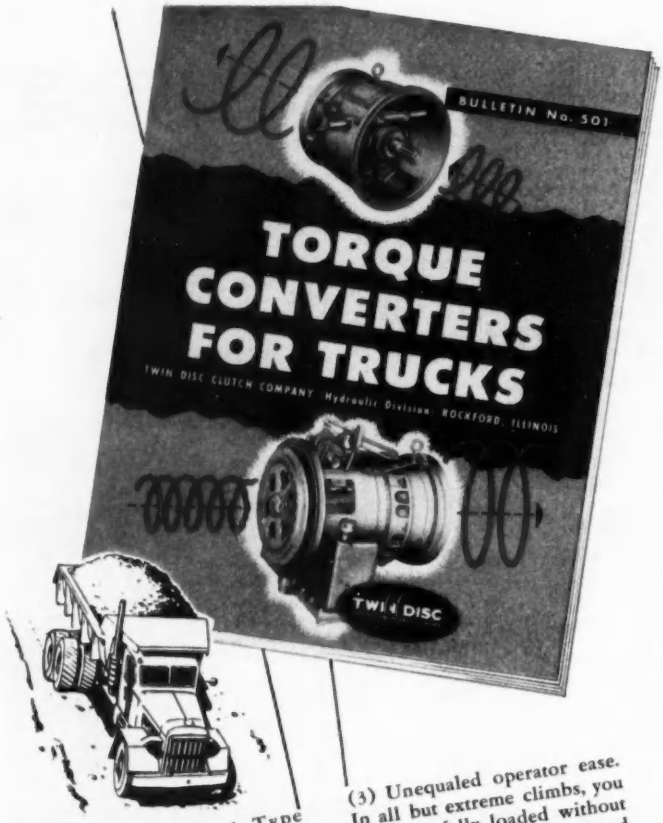
THE WORLD'S LARGEST MANUFACTURERS OF FUEL INJECTION EQUIPMENT FOR DIESEL ENGINES

Depots and Service Agents in over 100 countries



C.A.V. Fuel Injection and Electrical Equipment

C.A.V. DIVISION OF LUCAS ELECTRICAL SERVICES INC., 653, TENTH AVENUE, NEW YORK 19, N.Y.
Sales Office: 14820 DETROIT AVENUE, CLEVELAND 7, OHIO


BULLETIN No. 501
TORQUE CONVERTERS FOR TRUCKS
TWIN DISC CLUTCH COMPANY, Hydraulic Division, ROCKFORD, ILLINOIS
TWIN DISC

Twin Disc Truck-Type Torque Converters are helping set new standards for operator ease, trip time and low maintenance in open pit mining. In mine after mine where loads are big and hauls steep, trucks equipped with Twin Disc's Converters have increased operating efficiency, cut hauling costs through triple advantages.

Only Twin Disc Truck-Type Hydraulic Torque Converters provide these exclusive advantages: (1) Highest (up to 6-to-1) torque multiplication, (2) Torque Converter braking, (3) Unequaled operator ease. In all but extreme climbs, you come up fully loaded without gear shifting, and descend empty without using the brake pedal!

Write for newest Truck-Type Torque Converter Bulletin (No. 501) to see which of Twin Disc's two converters—Model CF for short, steep hauls or Model DF (with direct drive) for longer hauls with intermittent climbing and descending—fits your requirements. Or contact your nearest Twin Disc Factory Branch.

Built for a Long Life . . .
Backed for a Lifetime

TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES

TWIN DISC CLUTCH COMPANY, Racine, Wisconsin • HYDRAULIC DIVISION, Rockford, Illinois

BRANCHES: CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEWARK • NEW ORLEANS • SEATTLE • TULSA

New Members Qualified

continued

Kansas City Section

P. E. Churchman (M), R. C. Greenlease (M), Stewart M. Johnson (A), Alfred D. Weir (M).

Metropolitan Section

A. J. Albrecht (J), Johan-Otto Gustaf Bjorling (J), Antonio Compare (FM), Donald A. Gotsch (J), Elbert E. Husted, III (A), Corydon M. Johnson (M), Robert A. Krumhansl (J), Henry Thomas Lorne (M), Elbert J. Minarcik (M), James Thomas Mowles (J), Paul Petrella (J), Charles W. Reinauer (A), John C. von Doehren, Jr. (M).

Mid-Continent Section

Billy Ray Archer (J), James Dwain Christian (J).

Mid-Michigan Section

G. Keith Glaza (M).

Milwaukee Section

Douglas E. Holt (J), Cheng Shih (M), Charles E. Stone (M), Stuart A. Woodward (A).

Mohawk-Hudson Group

Dale H. Brown (M).

Montreal Section

L. Roland Dubois (A), Anthony Marshall (A), Martin Christian Petersen (A), Donald R. Seymour (M).

New England Section

Earl L. Auyer (M), Edward Thomas Giblin (J), John E. Healey (A), Alwin Edward Hodson, Jr. (J).

Northern California Section

Dain B. Lones (M).

Northwest Section

Albert T. Baines (A), Martin L. Headman (M).

Oregon Section

John E. Follen (A).

Philadelphia Section

George J. Elser (M), Robert H. Gasch, Jr. (J), Robert A. Gegan (A), Ernest G. W. Johnston (M), Richard Ludwig (J), Richard E. Newman (A).

Continued on Page 131

Now—Get the Advantages of Torque Converters on Your Biggest Trucks—with

The New Fuller 4-FS-1440

In keeping with its tradition of setting the pace with "The Best for the Biggest," Fuller announces its new 4-FS-1440 Transmission with closely spaced ratios for use with truck-type torque converters. This new unit makes new load-and-road performance possible in heavy duty service.

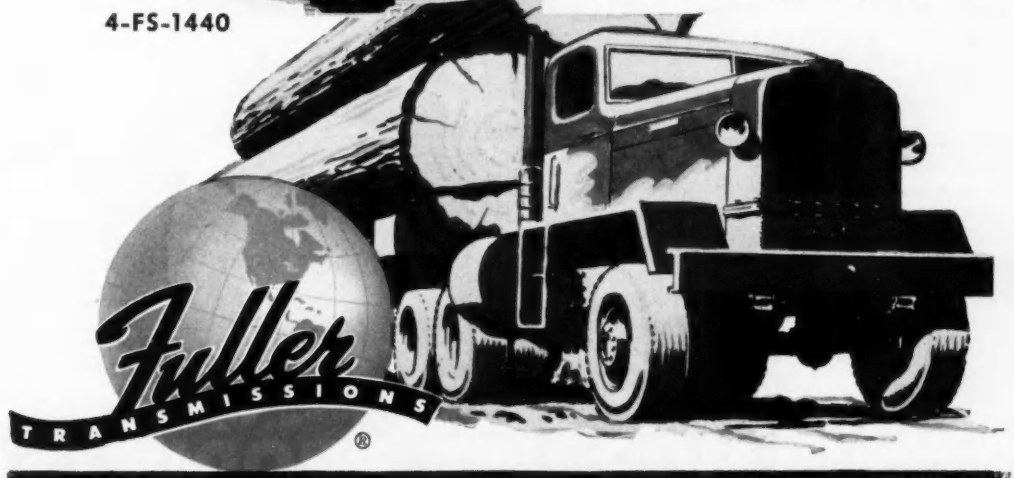
Built to deliver the power from the biggest automotive diesel engines now available plus ample capacity for high torque multiplication from the most advanced torque converters, the new 4-FS-1440 puts up to 400 hp. to work efficiently and dependably.

For maximum service plus maximum versatility in the toughest of heavy hauling, investigate the new 4-FS-1440. Write for performance and application data.

4-FS-1440

VITAL STATISTICS

Hp. handled—400. Speeds forward, 4: first, 1.98; second, 1.40; third, 1.00; fourth, .71. Reverse, 1.61. Weight 775 pounds.



FULLER MANUFACTURING COMPANY (Transmission Division), KALAMAZOO 13F, MICHIGAN

Unit Drop Forge Division, Milwaukee 1, Wis. • WESTERN DISTRICT OFFICE (SALES & SERVICE—BOTH DIVISIONS), 1060 E. 11th Street, Oakland 6, Calif.

Using the right friction material

IMPROVES PERFORMANCE!

Moraine's proved ability to mass-produce specially developed parts incorporating friction materials, is acknowledged by industry. A wide range of materials, including sintered metal, and various semi-metallic and non-metallic facings, offer different frictional characteristics as required.

Applications are broad. Moraine materials are in standard use on automatic transmissions such as Hydra-Matic, Powerglide, and Dynaflow. The basic techniques involved have many additional applications in the automotive and household appliance fields and in military vehicles, apparatus, and equipment.

Look to Moraine if you are using substantial quantities of parts incorporating friction material facings.

Parts shown are typical

MORAINE PRODUCTS

DIVISION OF GENERAL MOTORS · DAYTON, OHIO

New Members Qualified

continued

Pittsburgh Section

Albert J. Bodnar (A), Paul W. Marshall (M), Fred G. Moser (A).

St. Louis Section

Bobby D. Collison (J), George Moore (M).

San Diego Section

G. Fred Anderson, Jr. (M).

Southern California Section

Clinton William Holeman (M), Jost A. Matzdorff (A), Herbert Bailey Miller (M).

Southern New England Section

George E. Canuel (M), Foster Earl Stough (J).

Texas Section

Bill Fortenberry (M), Luke Johnson (M), King A. Koch (J), William Gross McMurry (A), Francis E. Sutton, Jr. (A), Evan H. Watkins (A).

Twin City Section

Robert F. Pomeroy (M), Chris Schou (M).

Virginia Section

Govan Cullen Faison (A), Robert E. Porter (A).

Washington Section

E. J. Lucas (A), Everette Randall Stillman (SM).

Western Michigan Section

Donald P. Hahn (M).

Wichita Section

Burt L. Whitlock (M).

Outside of Section Territory

Quentin William Crane (A), Charles B. Hanssen (J), Bernard H. Hershkowitz (J), Martin LaMar Loose (A), Alexander J. Mustard (M), Francis Price (M), Walter Henry Roberts (J), Vernon L. Rugen (M).

Foreign

Peter Ovadias (FM), Greece; Furhok K. Tangree (FM), England; Sergio Vittorelli (FM), Italy.

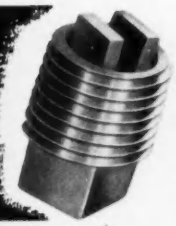
CUT
SERVICE
Guarantee Costs
on
TRANSMISSIONS

LISLE *Magnetic*
DRAIN PLUGS

Damage to intricate gears and bearings in automotive transmissions can be greatly reduced by installing Lisle Plugs as original equipment.

Abrasive metal that flakes off moving parts and circulates in the lubricant is caught and held by a strong permanent magnet in the Lisle Plug.

Replace Ordinary Plugs with LISLE PLUGS



To Remove IRON and STEEL Particles from Oil

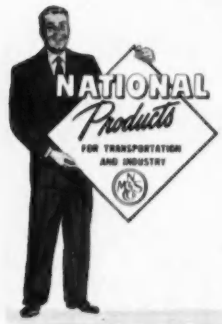
WRITE

today for your FREE *sample Lisle Plugs. Just state size and type of plug desired.*

LISLE *Corporation*
CLARINDA, IOWA

Castings by National

selected for Quality and Dependability



Products bearing these familiar trademarks have all established enviable reputations for quality and dependability.
These manufacturers *continue* to procure castings by National—one of the Nation's largest founders.

NORTHWEST · EATON · MW · Kelsey-Hayes · AC · Budd · CATERPILLAR · American-Standard · TIMKEN Detroit AXLES · BALDWIN BLH LIMA-HAMILTON

National's unparalleled experience in producing malleable, heat-treated malleable, and steel castings is at your disposal. Sales offices and engineering facilities are located at all five strategically located plants. A-5546

PLANTS LOCATED IN Sharon, Pa., Cleveland 6, Ohio, Indianapolis 6, Ind., Melrose Park, Ill., and Chicago 50, Ill.

SEE "This Moving World"

A 16mm technicolor film. Narrated by Edwin C. Hill, this 27-minute film tells how malleable iron is made . . . tested . . . used . . . how its production economy, ductility, machinability, toughness will give you a better finished product. Available for group showings.

NATIONAL Products FOR TRANSPORTATION AND INDUSTRY

NATIONAL MALLEABLE and STEEL CASTINGS COMPANY
CLEVELAND 6, OHIO
Est. 1868

Applications Received

The applications for membership received between Aug. 10, 1952 and Sept. 10, 1952 are listed below.

British Columbia Section

Frank Melville Francis, John Edmund Umiker.

Buffalo Section

Melvin Lawrence Armbruster, Eugene Anthony Czeck, Phillip B. Eyre.

Canadian Section

Eugene Canby, Herbert Aubrey Staneland.

Central Illinois Section

John Corser, Richard B. Curry, L. Burton Greer, Robert Allen Kirk, Frank A. Kottmeier, William H. Neptun, Frederick William Riddell, Louis J. Templin, Russell Junior Tobler.

Chicago Section

Robert L. Bassett, Carl Rex Canfield, Jr., Edward W. Christiansen, William Czapar, T. M. Ephgrave, George L. Frandsen, Simon K. Ghen, John J. Kadlec, J. Gordon Knapp, Donald Dawson MacKenzie, Julius E. Mikulak, Richard George Moen, Leonard W. Okon, Howard L. Philippe, Raymond Pociask, Robert W. Powell, Peter Francis Rath, Lone O. Reedy, Joseph Francis Szekely, Richard Graham Walsh, John Charles Zipperer, Jr., G. Peter Blom.

Cincinnati Section

Sidney Nathan Dexter, Max Richard Gramly, Jr.

Cleveland Section

Charles Balough, Jr., Robert Galen Farr, Cornelius Fiocco, W. H. Glidden, Paul Thomas Johnson, David L. Kerr, George Nicholls Lounsbery, Roy A. McKinnon, Willard W. Nelson, Donald F. Rader, Nocholas Olek.

Colorado Group

Paul Gustav Anderson.

Dayton Section

Paul J. Long, Jr., Sanford Lustig, Harold C. Mott, Donald D. Weidhuner.

Detroit Section

Theodore William Bayler, Robert J. Benya, Harold A. Buchanan, John H. Cauley, John Benjamin Clark, Jr., Robert Emmett Conklin, Fred Conley, Clyde Carl Culver, Robert J. Dika, William C. Dorr, Joseph Raymond Gillette, Thomas Golec, Jr., Jack W. Hawkins, Jack Donald Hinton, Alfred N. Iknayan, John J. Jarvie, Robert P. Jensen, Ralph Horace Johnson, Robert O. Kindt, Michael R. Krause, Allen M.

Continued on Page 134

You can save MONEY and MATERIALS with ROLLED BUSHINGS

FEDERAL-MOGUL

FEDERAL Mogul SINCE 1899

FEDERAL-MOGUL CORPORATION 11035 **SHOEMAKER, DETROIT 13, MICH.**

YOUNG MEN
OF VISION

Their future is based on decisions made today. The secret of success at Indiana Gear is to visualize . . . create . . . prove . . . and then move on to conquer the next problem. Indiana Gear proves from past success in a highly competitive business that its policy of using master craftsmen, fine equipment, skilled sub-contractors, and "young men of vision," exemplifies the perfectly coordinated planning so necessary to solve the gear problems of today.

INDIANA GEAR

The driven gear shown here is 5" in pitch diameter and 15" long overall. It is carburized and hardened with heat-treating distortion held within .001".

INDIANA GEAR WORKS • INDIANAPOLIS 7, INDIANA

Applications Received

continued

Kushner, Robert C. Lang, Stephen L. Mathewson, Carroll R. McBeth, Ralph A. Meyering, Joseph J. Mitchell, Jr., James A. Nagy, DeLane D. Patton, Ralph Joseph Rays, Stephen John Rogers, Richard Glen Ruffe, Charles L. W. Seith, Ervin Edward Siegrist, Robert Lee Simpkins, Mitchell Wayne, Clyde P. Westfall, Robert Kwoh-Tao Woo.

Hawaii Section

Henry Oscar Lai Hipp, John Ferguson Mellen, Herman W. Sivley, Max E. Suder.

Indiana Section

Werner W. Berger, Richard Thomas Clark, Harvey F. Dick, Henry A. Geisler, Wendell H. Kern, Rudy A. Walter.

Kansas City Section

Merrill A. Elliott, Joseph Frey, Paul Edward Tomshany.

Metropolitan Section

David Albin Anderton, Richard Drukker, Jr., Alfred M. Fischer, Walter Joseph Handlen, Henry N. Godbey, Jr., Stefen J. Harvey, Simm T. Jung, Frank Lynne Martin, John Perry, Herbert Wallace Saltzman, Edward N. Townsend, Jr., Richard A. Wester.

Mid-Continent Section

Joseph G. Evans, Richard Arthur Mengelkamp, Laurence D. Reis, John A. Rizzardi.

Mid-Michigan Section

Jack K. Barnhart, Howard P. Freers, John Allen McDougal, James Delmer Pembleton, Jr., George L. Punches, Harry J. Scott, Eldon Williard Tibbits, Richard N. Wright.

Milwaukee Section

Rodney Owen Berger, Leslie A. Cantley, Robert Elden Niva, Merle H. Peterson, George William Taivalkoski.

Montreal Section

Georges Donato, James Maskell.

New England Section

Harvey Joseph Lander, Russell Leonard Lawson, Allan Richard Smith.

Northern California Section

George Richard Picolet, Orrin Mitchell Prouty, Jr., Vernon L. Rogallo, Jess Virgil Terry, Dennis James Treadway.

Oregon Section

Richard Eugene Crandall, Leonard W. Peoples.

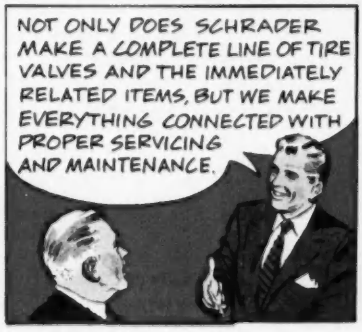
Philadelphia Section

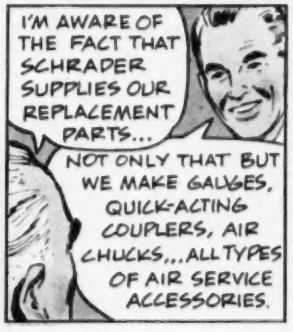
Allan T. Cowell, Paul Horn, Hugh

Continued on Page 136

Schrader Contributions to the Tire Industry

WE'RE ALWAYS ADDING TO OUR LINE BECAUSE AS THE LEADERS IN OUR FIELD, TIRE MANUFACTURERS TURN TO SCHRADER WITH THEIR PROBLEMS AND THE SOLUTION USUALLY MEANS SOME NEW SCHRADER PRODUCT.


NOT ONLY DOES SCHRADER MAKE A COMPLETE LINE OF TIRE VALVES AND THE IMMEDIATELY RELATED ITEMS, BUT WE MAKE EVERYTHING CONNECTED WITH PROPER SERVICING AND MAINTENANCE.


I'M AWARE OF THE FACT THAT SCHRADER SUPPLIES OUR REPLACEMENT PARTS...
NOT ONLY THAT BUT WE MAKE GAUGES, QUICK-ACTING COUPLERS, AIR CHUCKS,..ALL TYPES OF AIR SERVICE ACCESSORIES.

WE'VE GOT EVERYTHING YOU NEED TO MANUFACTURE AND SERVICE YOUR TIRES.
YOU'RE RIGHT, AND THAT'S WHY WE LOOK TO SCHRADER NOT ONLY FOR TIRE VALVES BUT ALL RELATED ITEMS AND SERVICE.

Schrader business is built on the basis of complete service to the tire industry. That's why we *must* maintain a complete line—you require it of us! We want to help you make your tires give better service and last longer. That's why Schrader offers you the largest and most experienced research and manufacturing facilities.

Is the solution to your tire valve problem another new Schrader product?

A. SCHRADER'S SON, 470 VANDERBILT AVE., BROOKLYN 17, N. Y.
Division of Scovill Manufacturing Company, Incorporated

Schrader
REG. U. S. PAT. OFF.

FIRST NAME IN TIRE VALVES
FOR ORIGINAL EQUIPMENT AND REPLACEMENT

PROBLEM... Dependable remote control of complex circuits!
SOLUTION... LEDEX CIRCUIT SELECTORS
Ledex Circuit Selectors and Stepping Relays are widely used for remote control of complex circuits to assure top product performance. They are powered by dependable Ledex Rotary Solenoids . . . available with various types of mountings . . . will control practically any number of circuits . . . and can be custom-engineered to fit your product. Let Ledex Engineers work with you to produce an efficient Ledex Circuit Selector or Stepping Relay for your product. Write today for complete information.
G. H. Leland INC.
123 WEBSTER STREET, DAYTON 2, OHIO

Applications Received

continued

Robertson Jackson, Carl S. Nau, Eugene M. Polter.

Pittsburgh Section

Robert F. Demmler, Howard N. Seese, Jr.

St. Louis Section

Herbert Douglas Anton, Wolf J. Beyer.

San Diego Section

Harry Felder, Carl W. Pieper, J. Holman Wood.

Spokane-Intermountain Section

John R. Bonner, J. G. Critzer, Edward D. Olson.

Southern California Section

Elmer C. Anderson, Ngaiman Au, Charles T. Aubrey, Clarence Samuel Brown, Jr., Joseph Milroy Brown, Charles A. Butler, Warren E. Douglas, Thomas M. Epperson, Frank S. Gadomcki, Jr., Verlin E. Goodman, Preston George Holland, Andrew Michael Krawicz, Oronzo L. Linsalato, Joseph Patrick Lynch, Edwin I. Mosher, Jr., Alan Tower Ries, Barney Joseph Sheridan, Vernon L. Stephan, Dale R. Thompson, Edward James Whitney, Norman Eugene Wood.

Southern New England Section

George F. Anger, Stanley J. Krol, Edward Richard Luff.

Syracuse Section

Clarence J. Hornbeck.

Texas Section

Richard Frank Burris, Julian E. Gerry, Jack Raymond Meadows, J. L. Osburn, B. P. Robertson, Abraham Tucker, James Sherwin Warnick.

Twin City Section

Don O. Benson, Joseph W. Howell.

Washington Section

Robert J. Gordon, Joseph A. Smith, Daniel Stern.

Outside of Section Territory

George W. Bird, Dale L. Brott, James D. Carmichael, Charles Aubrey Davidson, Charles F. Eisele, Stanley Park Funkhouser, Richard Thomas Gainey, Hugh McBain, F. R. Meehan, Grover Clinton Mellin, Jr., Dwight H. Pearson, John P. Sandoval, David Schafale, Roy F. Schwegler, J. Waldo Seiple, Robert C. Souers, Richard Willard Straw, Sr., Clarence Lester Walker.

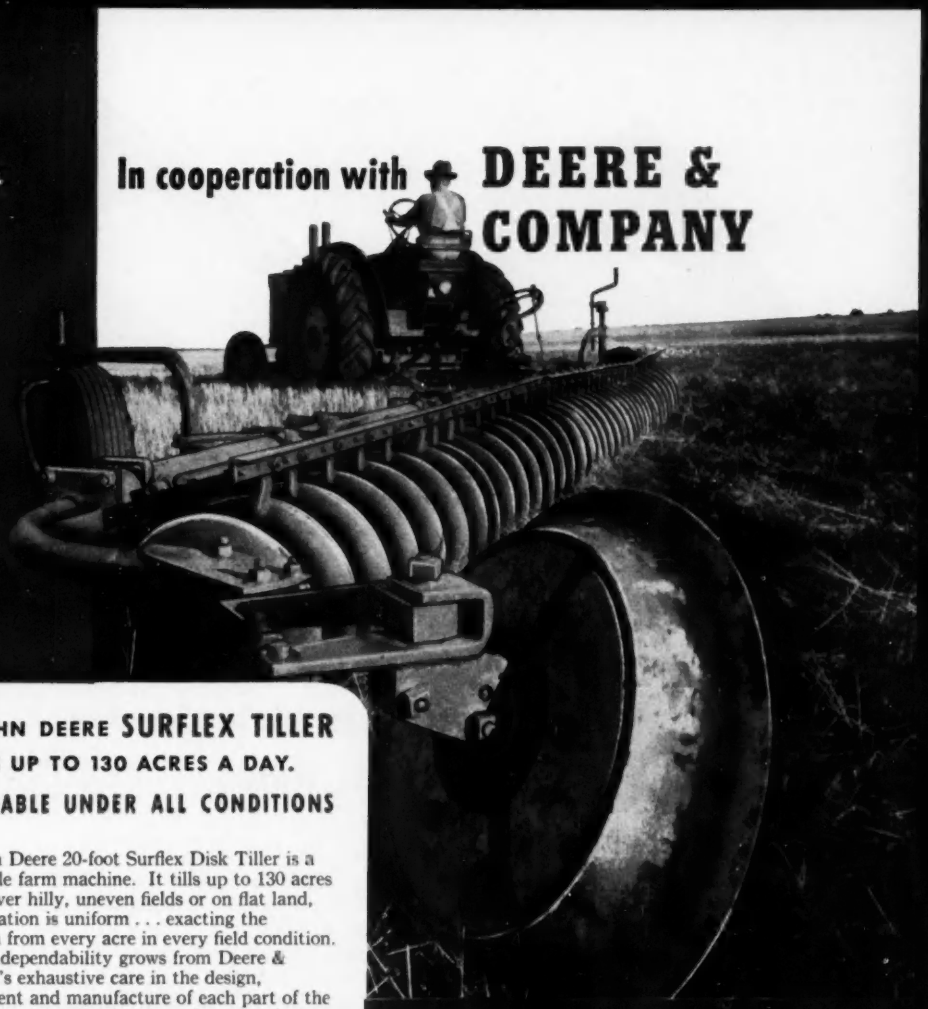
Foreign

John Bell Christian, Trinidad; Rodolfo Martinez DeVedia, Argentina; F. Karl Goerner, Germany; Max E. Lawton, Australia; Richard Francis McGill, Belgium; Amilcare Porro, Italy.

THE SEAL OF
COOPERATIVE
RESEARCH

C/R

In cooperation with DEERE & COMPANY



The JOHN DEERE SURFLEX TILLER WORKS UP TO 130 ACRES A DAY. DEPENDABLE UNDER ALL CONDITIONS

This John Deere 20-foot Surflex Disk Tiller is a remarkable farm machine. It tills up to 130 acres a day. Over hilly, uneven fields or on flat land, its penetration is uniform . . . exacting the maximum from every acre in every field condition.

Surflex dependability grows from Deere & Company's exhaustive care in the design, development and manufacture of each part of the unit. Each of the disk bearings, for example, is protected by a C/R Type "V" diaphragm oil seal with a leather sealing surface. Obviously, these seals must exclude every trace of the ever-present dirt in which the tiller operates.

As is the case with all C/R "Perfect" oil seals, those for the John Deere Surflex Disk Tiller were developed in cooperation with the manufacturer's engineers.

Each C/R seal is designed to do a specific job of protecting bearings under a variety of tough operating conditions. And, each C/R seal does that job as well as it can be done.

That's why, when you have a problem of lubricant retention, or foreign matter exclusion, it will pay you to check with C/R engineers *first*.

P. S. For immediate delivery, C/R "Perfect" oil seals are stocked in over 1800 sizes covering 15 different types.

The cooperative research and engineering services which C/R has provided in producing special C/R oil seals (both synthetic rubber and leather) for leading manufacturers are available to you. We will be pleased to send you any information you wish. Brochure on request.

C/R

Oil Seals

sirvis

Mechanical Leather Products

Boots, diaphragms, packings and other products give dependable service under difficult operating conditions.

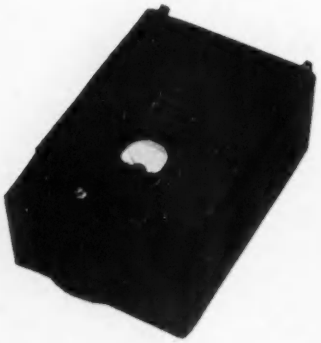
SIRVENE

The Scientifically Compounded Elastomer

Custom-engineered and custom-built for critical service in aircraft, automotive and other mechanisms.

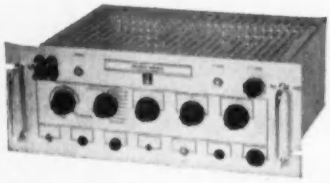
Representatives in these Principal Cities

Boston • New York • Syracuse
Philadelphia • Pittsburgh • Cincinnati
Cleveland • Detroit • Peoria
Minneapolis • Kansas City • Houston
Los Angeles • San Francisco



AMPLIFIES LOW VOLTAGES

Analysis of static or dynamic conditions involving either high or very low forces is simplified with this Brush Direct-coupled Amplifier. Used with the Brush Magnetic Oscillograph, any need for complicated intermediate equipment is eliminated. The direct-coupled Amplifier has high sensitivity and low drift . . . zero signal drift not more than one chart millimeter per hour.



RACK-MOUNTED STRAIN ANALYZER

This new Brush Strain Amplifier, functionally similar to the standard table top model, is designed for mounting in a standard 19-inch rack. When used with the Brush Direct-Writing Oscillograph, the equipment records either static or dynamic strains with direction and magnitude shown on the chart. Operation is simple, records are immediately available and easily interpreted.

SHOWS SURFACE PROFILE

The Brush Surface Analyzer® shows average roughness in micro-inches, and also provides a chart of surface irregularities. The chart shows a highly magnified profile of the surface, on which varations of less than 1 micro-inch are readily apparent. Eliminates guesswork in specifying and checking finishes.

For complete information write The Brush Development Co., Dept. EE-42, 3405 Perkins Ave., Cleveland 14, Ohio

Charts instantaneously... Saves time!

● You eliminate laborious testing and plotting of data when you use Brush Recording Analyzers. Static or dynamic phenomena, electrical or mechanical in nature, can be recorded instantaneously with high accuracy.

This two-channel Brush Magnetic Oscillograph, used with the proper Brush Amplifier, makes a direct dual-chart recording of voltages, currents, or physical phenomena such as strains, pressures, accelerations, torques, forces, displacements, or vibrations. Either direct inking or electric stylus models are available.

Flexibility is a major advantage with the Brush Oscillograph. Chart speeds of 5, 25, or 125 mm. per second can be selected readily. An auxiliary chart drive for slower speeds is available. Other accessory equipment provides event markings for an accurate time base, or for correlation of events.

Apply time-saving Brush instruments to your testing problems . . . in the laboratory, on the test floor, or in the field. You'll get expert technical assistance from Brush representatives located throughout the U. S. In Canada: A. C. Wickman, Limited, Toronto.

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Now the public has

SEEN...

TRIED...and

APPROVED

SAGINAW *Hydraulic* POWER STEERING

* Now on 1952 model Oldsmobiles, Buicks and Cadillacs

Saginaw hydraulic power steering is in the news! Recently, the general public caught its first glimpse of this wonderful new device on passenger cars. Shown on 1952 model Oldsmobiles, Buicks and Cadillacs in showrooms across the country, it captured the imagination of the public. Thousands tried it—and approved of what they found. For "there is no steering like *power* steering . . . and no power steering like Saginaw hydraulic power steering."

Already Saginaw power steering has proved its value . . . proved it on thousands of commercial vehicles since it was introduced in 1939 to make the steering of heavy-duty trucks and buses easier and safer. And during World War II many of America's giant tanks were Saginaw equipped.

Saginaw power steering can be easily adapted to any make or model automobile, and Saginaw engineers are available to work with car manufacturers at any time on new applications.

Remarkably simple in design, Saginaw power steering has fewer moving parts, fewer parts in all. "Wheel pull" is easily adjusted to the individual requirements of any car.

Write Saginaw Steering Gear Division of General Motors for full details.

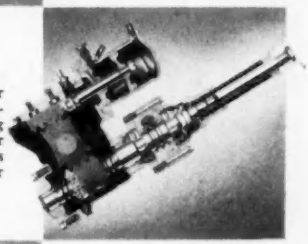
IF IT'S EASY TO STEER . . . IT'S A SAGINAW GEAR

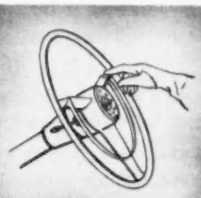
This...

Saginaw's recirculating ball steering gear provides almost frictionless operation that no other type of gear can equal. This principle has been proved on over a million automotive steering gears.

Plus this...

Saginaw's hydraulic power steering gear gives a tremendous lift to driving ease. A hydraulic booster does the work . . . replaces driver effort with power steering.





Equals this...

Parking is a simple matter in a car equipped with Saginaw power steering. The smallest woman can spin the wheel of the biggest car with finger-tip ease.

**Optional equipment at extra cost.*

Saginaw

STEERING GEAR DIVISION

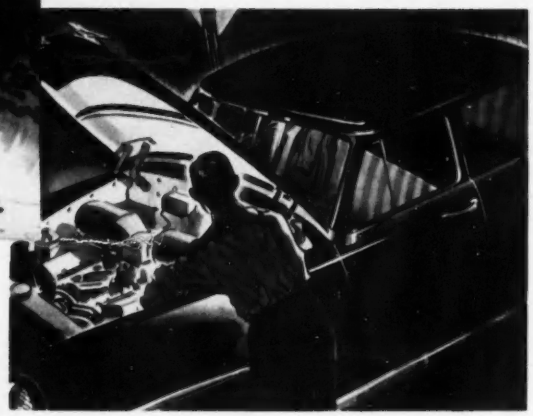
General Motors Corporation, Saginaw, Michigan

SSG PRODUCTS

STEERING GEAR ASSEMBLIES • STEERING LINKAGE ASSEMBLIES • PROPELLER SHAFTS • DIESEL ENGINE AND AIRCRAFT PARTS

Why Put Up with . . .

FUSE BURNOUTS *and* ROAD DELAYS



when KLIXON *Permanent Circuit Breakers*

ELIMINATE THIS TROUBLE

The road experience of numerous fleets conclusively proves that Klixon permanent circuit breakers keep equipment rolling by safeguarding electrical circuits.

Because they replace expendable fuses, they prevent road delays caused by fuse burnouts and lack of spare fuses. Properly applied Klixon breakers prevent the possibility of over-capacity fusing. They guard against possible fires because operators need not insert jumpers as the case might be when fuse replacements are not available.

Klixon Circuit Breakers are available in a wide range of types and ratings. Write for information.

KLIXON

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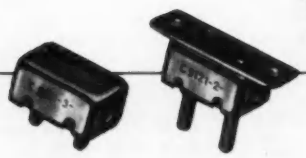
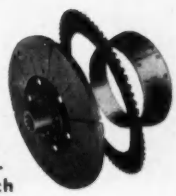


TYPICAL KLIXON CIRCUIT BREAKERS

JOIN THE LEADERS

The preference of experienced design engineers for Velvetouch, is based on performance records that prove Velvetouch lasts longer. And it lasts longer . . . because it's all-metal! Leading equipment manufacturers everywhere specify genuine Velvetouch clutch plates, facings and brake linings wherever operating conditions are extremly severe. They know they can depend on Velvetouch! It lasts longer . . . won't rot or glaze like asbestos . . . delivers uniform friction action. And with Velvetouch, due to its powdered metals make-up, a friction surface can be developed to meet your individual needs. Our engineers will gladly consult with you. Either contact our nearest branch . . . or write The S. K. Wellman Co., 1374 E. 51 St., Cleveland 3, Ohio



Velvetouch

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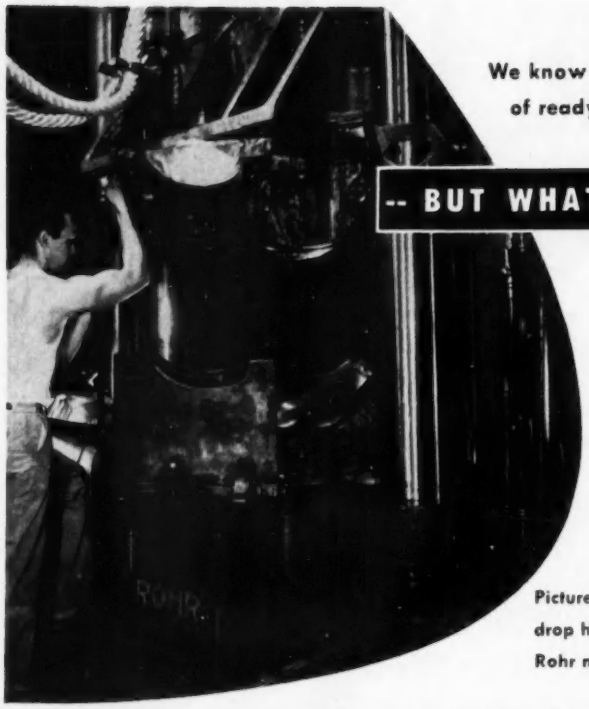

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-- BUT WHAT ELSE DOES ROHR DO?

Today, Rohr aircraftsmen are producing more than 12,000 different parts for both commercial and military aircraft. Rohr assembles these many parts into more than 840 products for Rohr customers.

Pictured here, one of many Rohr-designed drop hammers, key equipment in the Rohr manufacturing methods.

ROHR

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OF READY-TO-INSTALL POWER PACKAGES
FOR AIRPLANES

ROHR
AIRCRAFT CORPORATION

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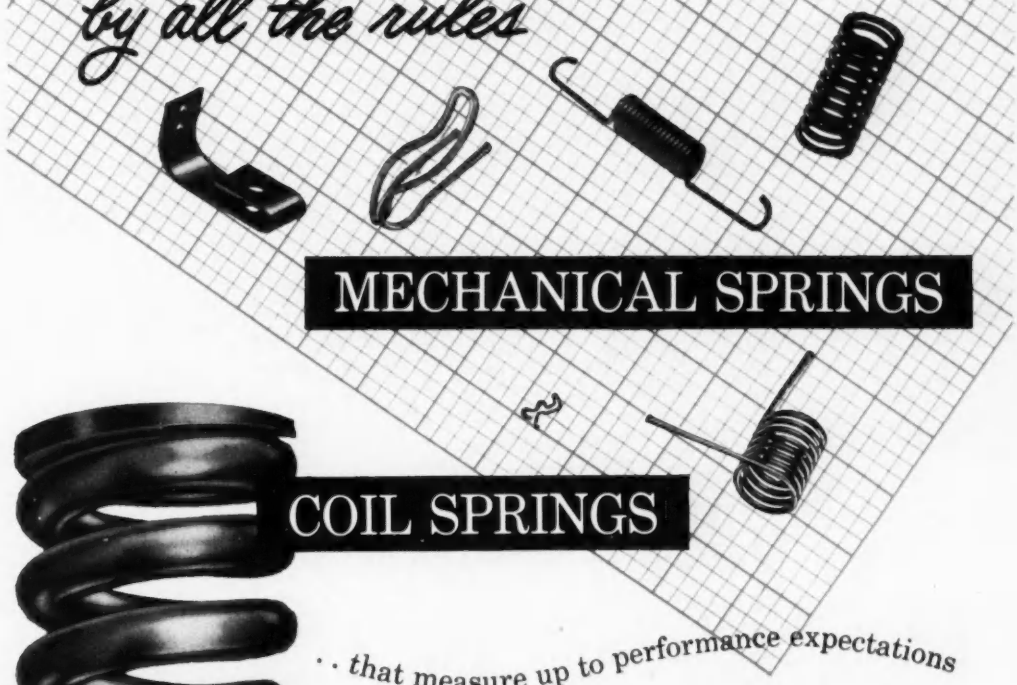
by all the rules



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COIL SPRINGS

. . that measure up to performance expectations

made by CHELSEA SPRING DIVISION
MUEHLHAUSEN SPRING DIVISION

Standard Steel Spring Company

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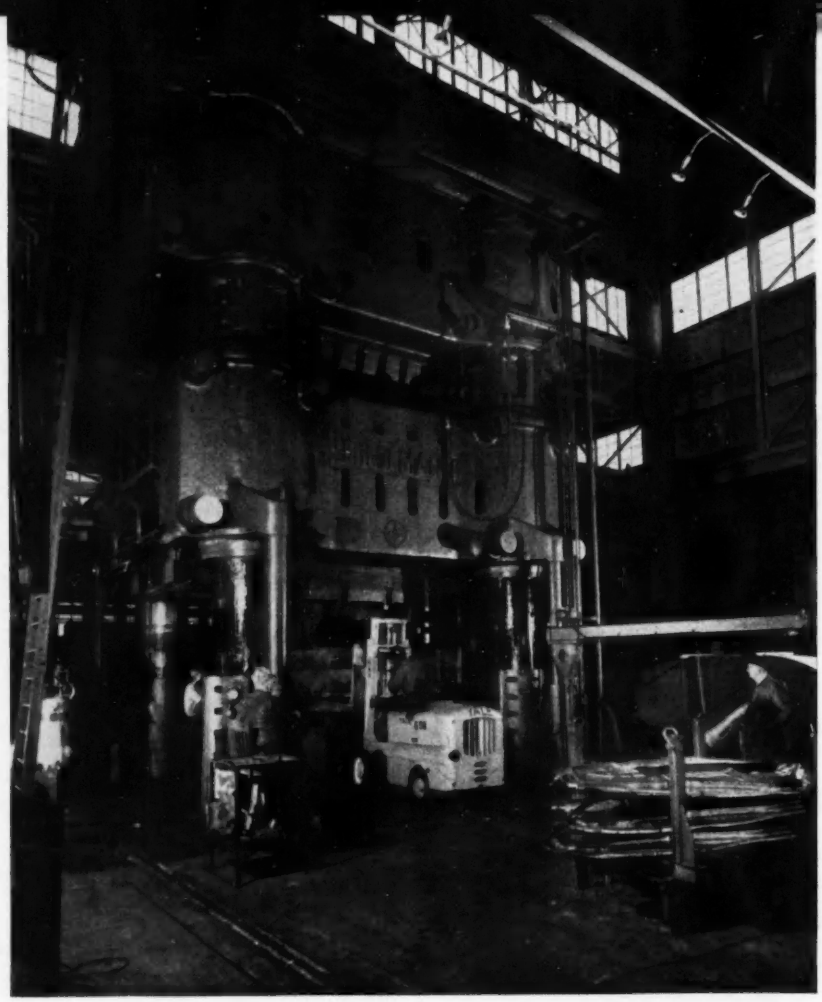
15,000-TON FORGING press recently installed in its own building at the Cleveland plant.



WHERE DO WE START TALKING TO YOU ABOUT FORGINGS?

We suspect that a lot of people think Alcoa only smelts and refines aluminum. If you are one of these, we should tell you first that Alcoa makes almost everything in aluminum—including forgings. We have big forge shops in Cleveland, Ohio; Vernon, California; and New Kensington, Pennsylvania. In fact, these are the largest aluminum forging facilities in the country. They have been making forgings for 30 years . . . backed by Alcoa's 64 years of aluminum experience.

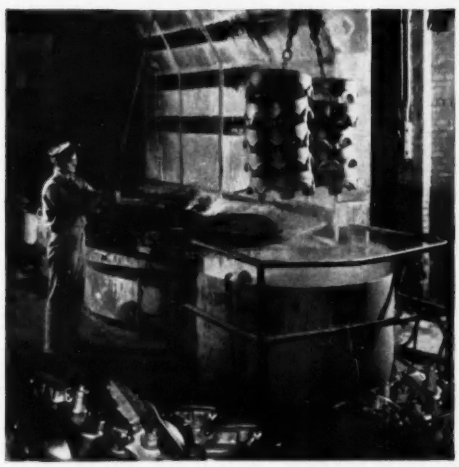
On the other hand, if you know that Alcoa makes forgings, perhaps we should begin by telling you that we make *all types and sizes* of forgings in *both* aluminum and magnesium. In addition to the personal help of your local Alcoa sales engineer, the facilities of the world's greatest aluminum research laboratories are at your disposal. You will find your local Alcoa sales office listed under "Aluminum" in the classified phone directory.

ALUMINUM COMPANY OF AMERICA 862-K Gulf Building

LARGE HAND FORGINGS are handled with a power-driven manipulator at Alcoa's Cleveland, Ohio, plant.

FORGING HAMMER forming an aircraft propeller blade.

DIE SINKING an impression in a steel block. The automatic duplicating machine reproduces the shape of the plaster model mounted above the die.



ETCHING crankcase forgings for final inspection. Magnesium forgings are also given a special oxide coating to preserve them from corrosion during storage and shipment.

ASK ALCOA FIRST
WHATEVER YOUR NEED IN ALUMINUM

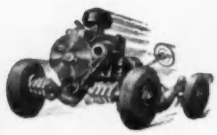
Your local Alcoa sales office is headquarters for "everything" in aluminum. Look for Alcoa under "Aluminum" in your classified phone book.

Pittsburgh 19, Pennsylvania

ALCOA

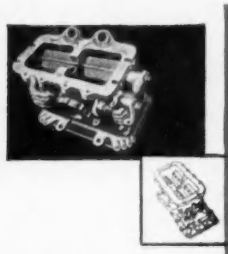
Ever see a helicopter grit its teeth?

When this helicopter's giant blade spins, tiny two-inch Lycoming gears—machined to tolerances of 1/10,000 of an inch—carry the load!



"Sinews" to give cars "go"

For any or *all* engine parts—pistons, transmissions, crankshafts and other essentials that can "take it"—leading auto manufacturers look to Lycoming.



Watch a plane's "lung" take a deep breath

To inhale 30,000 pounds of air an hour, an engine needs good lungs—the Lycoming fuel-injection body that never leaks or coughs at any speed or altitude.

LYCOMING PRESENTS

a representative group of its achievements considered of outstanding importance by America's military and industrial leaders

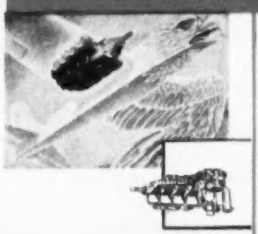
For a more complete story on Lycoming write—on company letterhead—for the booklet "Let's Look at Lycoming."

Here, through the eyes of a leading American illustrator, Lycoming demonstrates how it is geared to meet the most exacting requirements of America's leading industries. From basic research to precision and volume production, Lycoming offers a versatility of skills, extensive facilities and well-rounded experience. *Whatever* your problem—look to Lycoming!

AIR-COOLED ENGINES FOR AIRCRAFT AND INDUSTRIAL USES • PRECISION-AND-VOLUME-MACHINE PARTS • GRAY-IRON CASTINGS • STEEL-PLATE FABRICATION

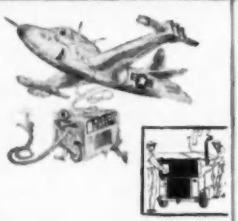
LOOK TO LYCOMING FOR RESEARCH FOR PRECISION PRODUCTION

LYCOMING-SPENCER DIVISION, BRIDGEPORT-LYCOMING DIVISION — AVCO MANUFACTURING CORPORATION — WILLIAMSPORT, PA., STRATFORD, CONN.



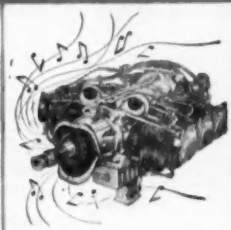
There's a new "beat" in this eagle's heart

Ready *reserve power* is an outstanding advantage of this sturdy new Lycoming aircraft engine—the only 400-horsepower air-cooled model produced today.



Hot "juice" for cold jets

This light, compact, portable Lycoming generator provides dependable all-weather starting power for jets—from 135° above to 65° below F.!



Its "song" fills the air

For dependable air-cooled engines in a wide horsepower range, many of the nation's leading aircraft manufacturers look to Lycoming!

AMERICA'S LEADERS LOOK TO LYCOMING

AIR MATERIEL COMMAND
BEECH AIRCRAFT CORPORATION
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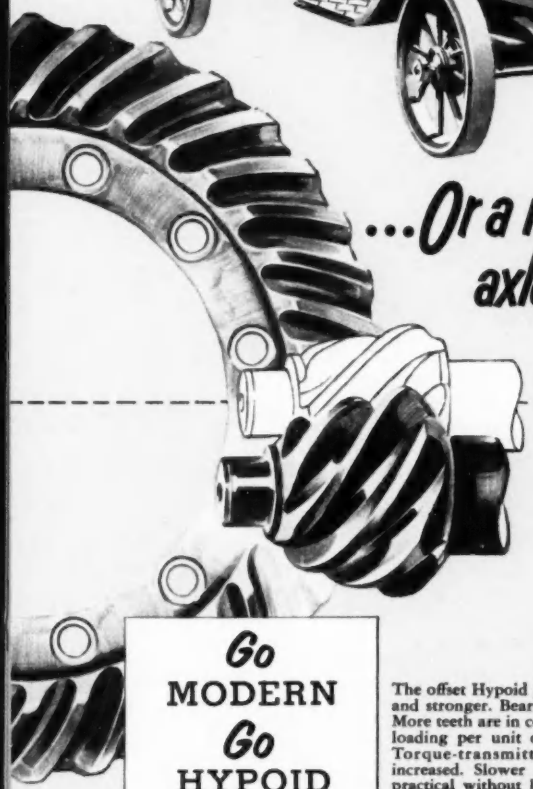
ILLUSTRATIONS BY ARTZYBASHEFF

Buy a truck without a starter? Of course not!...



...Or a modern truck without Hypoid axle gearing? Certainly not!

When you buy a truck today you take for granted such modern improvements as the self-starter. But don't take *too much* for granted! Make sure the trucks you buy are equipped with modern, cost-cutting Timken-Detroit Hypoid gearing! No other heavy-duty axle gearing gives you so much day-to-day ruggedness and dependability with so little maintenance cost.

Designed, engineered and produced for heavy-duty motor vehicles by Timken-Detroit, Hypoid gearing has been *proved* by billions of miles of trouble-free, on-the-job operation. Moreover, this modern axle gearing steps up performance—provides plenty of strength and power both on the highway and off.

The next time you buy trucks look for, and insist on, the mark of a *modern* truck—Hypoid gearing! It's available on all trucks equipped with Timken-Detroit Axles and Brakes.

Go MODERN Go HYPOID

The offset Hypoid pinion is bigger and stronger. Bearings are bigger. More teeth are in contact, reducing loading per unit of contact area. Torque-transmitting capacity is increased. Slower gear ratios are practical without loss of strength.

Only Timken-Detroit offers Hypoid Gearing in all three types of final drives . . . single-reduction, double-reduction and two-speed double-reduction . . . in a complete range of capacities.

WORLD'S LARGEST MANUFACTURER OF AXLES FOR TRUCKS, BUSES AND TRAILERS

TIMKEN Detroit AXLES

A PRODUCT OF THE TIMKEN-DETROIT AXLE COMPANY
DETROIT 32, MICHIGAN

The Accepted Standard — TRADE MARK REGISTERED

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For a factory-type replacement job...

Buy genuine TIMKEN-DETROIT AXLE PARTS in kits!

Are your trucks Timken-Detroit-equipped? If so, make sure they *stay* that way! Install *only* genuine Timken-Detroit Replacement Parts when your axles and brakes need parts.

Many genuine Timken-Detroit Axle Parts are packaged in convenient kits which contain all the essential related parts to do a factory-type repair job. Specialized kits for many different axle and brake replacement jobs are available—every part identical with the original equipment. Maintenance is easier, longer-lasting, more complete.

Always insist on genuine Timken-Detroit Axle and Brake Replacement Parts when new parts are needed. Buy them in protective, money-saving kits. You'll find them wherever the Timken-Detroit Axle Parts sign is displayed.

THE SIGN OF
GOOD TRUCK MAINTENANCE
Look for it!

Genuine
TIMKEN
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AXLE PARTS

The Accepted D A Co Standard
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THE TIMKEN-DETROIT AXLE COMPANY
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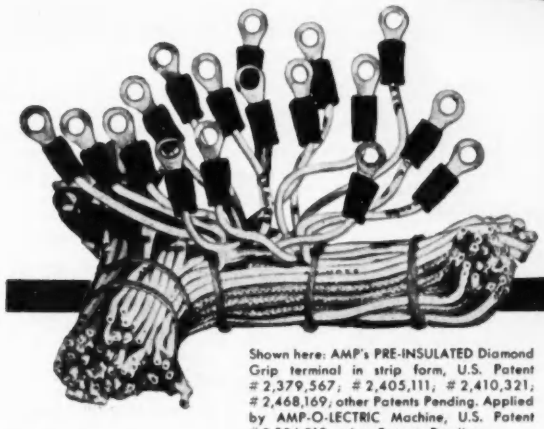
Plus lowest installed cost of any *insulated* wire termination!

Combination of AMP Automatic Wire Terminators and AMP PRE-INSULATED* strip terminals gives an all time high in precision and uniformity at lowest possible unit cost. All the advantages of solderless methods plus SPEED. No heat, no solder, no irons or flux, no cold joints; no separate insulation tubing. Yet tests prove AMP terminals superior in all respects: conductivity, tensile strength, resistance to corrosion, vibration and bending, heat, etc. Human error in terminal application is all but eliminated! Connections are free from R.F. Noise; safe for most critical applications.

SEND FOR SPECIAL AUTOMATIC MACHINE CATALOG!

THE ONLY AUTOMATIC WIRE TERMINATOR *PROVEN* BY YEARS OF CONTINUOUS SERVICE! WRITE FOR A DEMONSTRATION IN YOUR PLANT!



Shown here: AMP's PRE-INSULATED Diamond Grip terminal in strip form, U.S. Patent # 2,379,567; # 2,405,111; # 2,410,321; # 2,468,169; other Patents Pending. Applied by AMP-O-LECTRIC Machine, U.S. Patent # 2,396,913; other Patents Pending.

*Trade-Mark
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NON-INSULATED AMP terminals and connectors can be applied at rates up to 4,000 terminations per hour!

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NATIONAL OIL SEAL LOGBOOK

Reprints from this or other Logbook pages are available for your files. Request them from our Redwood City, California office

Helicopter transmission gear assembly offers challenging array of oil sealing problems

Good mechanical design and careful engineering have effectively solved a complex oil sealing problem in the main power transmission assembly of the Hiller Helicopter. This assembly uses planetary gears in a light-weight magnesium housing and requires lubricant sealing at several points.

At the top of the gear housing (Figure 1) it is necessary to seal the vertical drive shaft against entry of dust, moisture, etc. It is also necessary to contain S.A.E. #40 oil introduced near the sealing point, rate-of-flow 4 to 5 pints per minute. A National 10,000-S Syntech* seal is used. This seal has a felt outer member to exclude foreign matter and a spring-loaded synthetic rubber inner member to retain the oil.

As the oil circulates down through bearings and bevel gears, it is necessary to seal the small horizontal tachometer drive shaft, the horizontal tail rotor drive pinion and a vertical fan drive pinion shaft. Here the problem is primarily retaining the lubricant, and conventional National 50,000-S Syntech seals provide effective sealing.

The most demanding oil seal problem is sealing the vertical sun gear drive shaft where it enters the bottom of the gear housing. The shaft revolves at 3,000 r.p.m., and the carrier set revolves at 328 r.p.m. This forms a turbulent oil "pocket" directly above the seal. The problem is further complicated by operating temperatures up to 230° F. Hiller achieves proper sealing at this point by using a National 50,000-S Syntech seal.

National Syntech seals with their precision-molded and accurately-trimmed synthetic rubber sealing members are particularly suited for difficult sealing problems of this type. Seals used by Hiller are of standard design, available in quantity with a minimum of tooling costs. Many sealing problems can be solved quickly and economically with standard design seals; others require special designs for special problems. In either case, National Oil Seal engineers can apply nearly 30 years of sealing experience toward solving the problem.

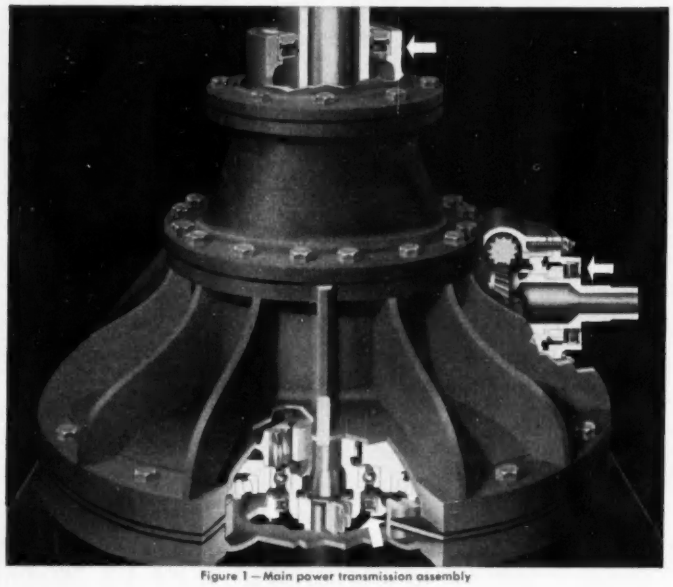

Figure 1 — Main power transmission assembly

National 10,000-S Series Syntech*

National 50,000-S Series Syntech*

Hiller Helicopter

* Trade Mark Registered

"Let Your Decision be Based on Precision"

NATIONAL OIL AND FLUID SEALS

NATIONAL MOTOR BEARING CO., INC.

General Offices: Redwood City, California
Plants: Redwood City, Calif.; Downey (Los Angeles County), Calif.; Van Wert, Ohio

2348

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DALLAS, TEXAS . . . *30½ Highland Park Village, Justin 8-8453*
DETROIT, MICH. . . . . *726 Lothrop Avenue, Trinity 1-6363*
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MILWAUKEE, WIS. . . *647 West Virginia Street, Broadway 1-3234*
NEW YORK CITY, N. Y. . *122 East 42nd Street, Murray Hill 6-0171*
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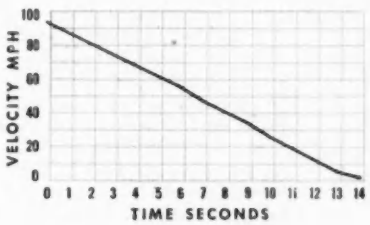
How to absorb 25 million FT-LBS of energy in 1000 feet!

This deceleration chart shows what happens when a pilot brings his 20 ton ship in for a landing. During this stop, terrific heats and pressures are created. Yet planes must stop safely... and quick!

American Brakeblok attacked this problem during World War II. Working closely with aviation brake manufacturers we developed the formulas to do the job. We helped solve some very difficult manufacturing problems, created mass-production methods and equipment.

Today we are a major supplier of aviation brake lining. Our research laboratories, manufacturing facilities and years of experience are ready to serve—either for military or civilian needs.



American Brakeblok

THE SAFETY BRAKE LINING

AMERICAN Brake Shoe COMPANY

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AMERICAN BRAKEBLOK DIVISION
DETROIT 9, MICHIGAN

Many fine new cars rolling off the assembly line are equipped with the latest advance to promote passenger comfort . . . the L·O·F Hoodliner that muffles engine sounds.

L·O·F Fiber·Glass Hoodliner reduces high-frequency sounds to a whisper

L·O·F Fiber·Glass also insulates roofs, trunks, and fire walls

TODAY, passengers enjoy the comfort of near silence in new cars and trucks through the use of the L·O·F Hoodliner. Installed under the hood, the Fiber·Glass Hoodliner mutes high-frequency engine sounds, tire whine and air-stream whistle.

Highly efficient, Fiber·Glass insulation absorbs sound and substantially reduces air-borne noise in cars and trucks. Lightweight, flexible, oil- and grease-resistant, the L·O·F Hoodliner is easily installed on the assembly line.

L·O·F Fiber·Glass is also supplied as superior insulation for roof liners, on fire walls, under package trays and as dash liners. And Libbey·Owens·Ford lives up to its reputation in the industry of meeting your schedules . . . *right on time!*

For more information, call L·O·F's Detroit office, 610 Fisher Building, Trinity 5-0080; or write, wire or phone Libbey·Owens·Ford, Dept. F·G 6102, Nicholas Building, Toledo 3, Ohio.

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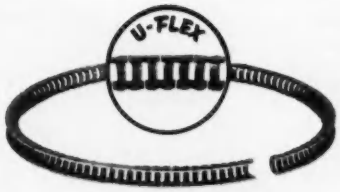
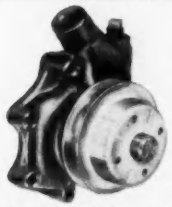
parts you can take for granted



U-FLEX OIL CONTROL PISTON RING



AUTOMOTIVE WATER PUMPS

VALVE SEAT INSERTS

CUTTING AND GRINDING MACHINE PUMPS

AUTOMOTIVE AND AIRCRAFT PISTON PINS

HEAVY DUTY CYLINDER SLEEVES

FOR over 50 years, Thompson Products has been making *original equipment and precision replacement parts* for cars, buses, trucks, tractors and industrial equipment—both diesel and gasoline.

From screw caps in 1901, Thompson's versatility has grown to include such vital engine parts as piston pins for powerful, dependable aircraft; valve seat inserts for rugged bulldog tanks; cylinder sleeves to stand up in toughest heavy-duty service; pumps to cool your product or your engine and the revolutionary, new U-Flex Oil Control Piston Ring.

Thompson is versatile! But more important, every one of Thompson's hundreds of automotive and aircraft parts have the reputation of being produced to the closest tolerances know to the industry. Automotive builders and repairmen agree, "*The name Thompson means original equipment precision parts that you can take for granted.*" They know "You can count on Thompson" for dependability of supply, quality, exact tolerances and maximum performance and service.

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Thompson Products, Inc.

2196 Clarkwood Road • Cleveland 3, Ohio

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Long Clutches mean Dependability!

Rugged, durable Long clutches have met the heavy-duty requirements of vehicle manufacturers since 1922.

From our wide range of clutch sizes and capacities, we have equipped millions of cars, trucks, buses, tractors and military vehicles.

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CLUTCHES • RADIATORS • TORQUE CONVERTERS
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IMPROVED BEARING DESIGN

means longer tractor life!

Farmers today are quick to notice that tractors and implements equipped with Bower Spher-O-Honed bearings operate efficiently with little or no bearing maintenance! This, and other important end-product advantages, can be traced directly to specific Bower engineering advances such as spherical roll-heads and flange surface, generous oil groove and smooth, precisely finished races. Put this extra value to work for you; specify Bower Spher-O-Honed bearings for your product!

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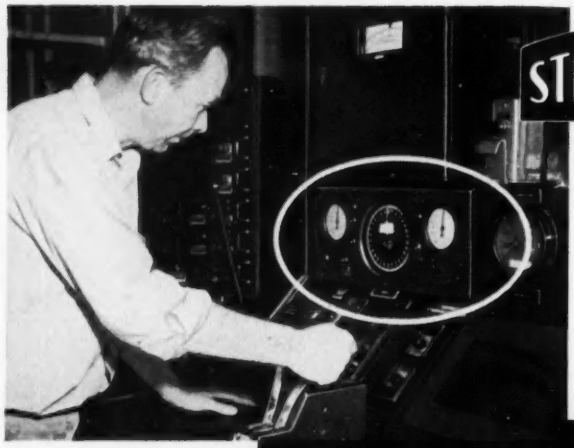


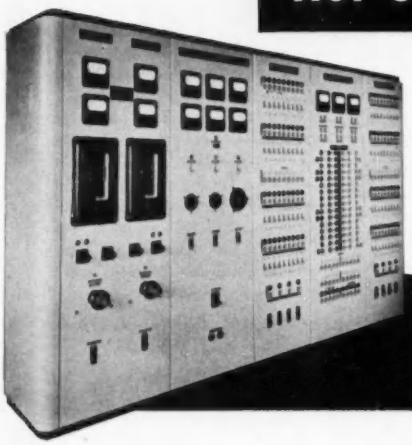
STANDARD

SINCE 1884

WRIGHT AERONAUTICAL DIVISION
CURTISS-WRIGHT CORPORATION

This photograph, taken in one of the experimental cells of the Wright Aeronautical plant at Woodridge, N. J., shows a STANDARD Chronotachometer installed in their test panel.

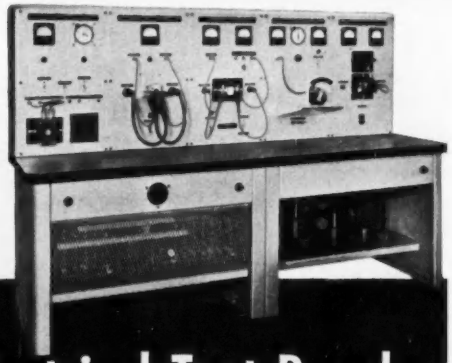
Not Only Chronotachometers . . .



WILSON DAM (T. V. A.)

This experimental control and distribution switchboard handles various power supplies for their Chemical Laboratory Building.

plus "flexlab" Control and Distribution Switchboards



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This specially designed unit is for the control and test of aircraft timers, series relays, contactors, servo motors, and booster coils. It is typical of the wide range of custom-built equipment by STANDARD.

. . . but all kinds of Custom-built Electrical Test Panels

THE STANDARD ELECTRIC TIME COMPANY

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"No wonder I say . . . no wonder everyone is saying . . .

Hooray for 100% "Electronic" Graphite!"

"ELECTRONIC" GRAPHITE is Eagle's trade name for a blend of purest crystalline graphites, reduced to micronic fineness in our exclusive Attrition Mill.

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Skillful planning and forward thinking today underwrite the needs of a swiftly changing world tomorrow. American Bosch is firmly committed to this modern industrial concept in research, field engineering and the most modern production facilities. It results in superior American Bosch Products. . . . Products that are known the world over for premium performance and dependable service. This is the significant reason so many American Bosch Products are in ever-widening use as preferred equipment by the aircraft, diesel and automotive industries. American Bosch Corporation, Springfield 7, Mass.

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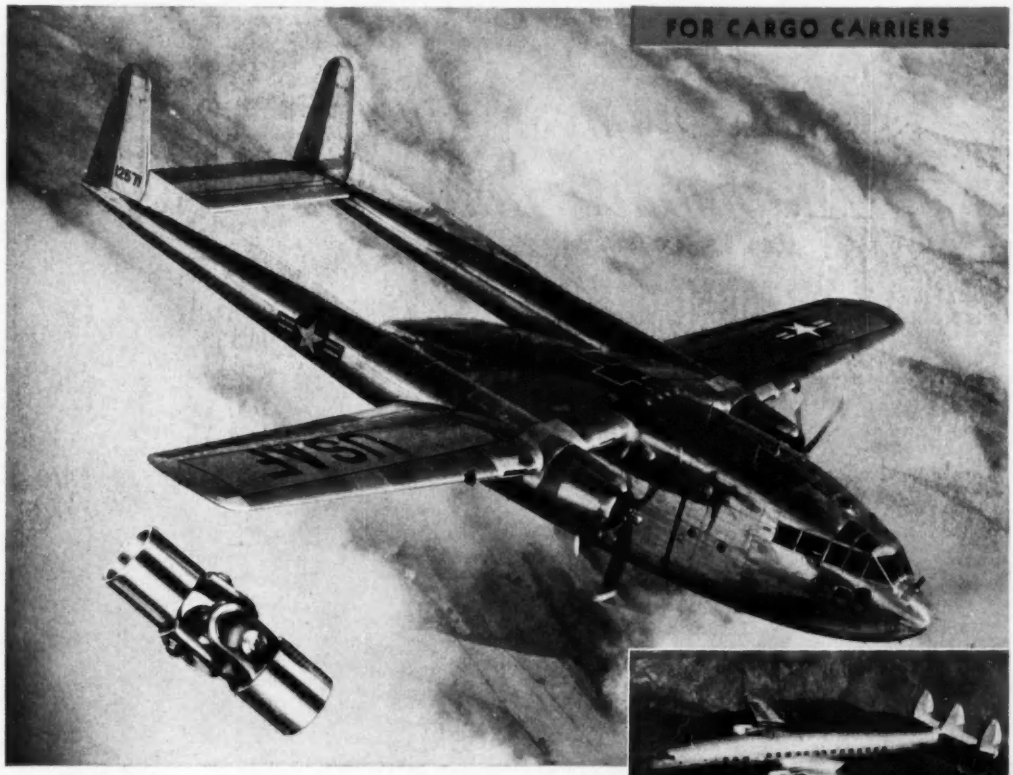

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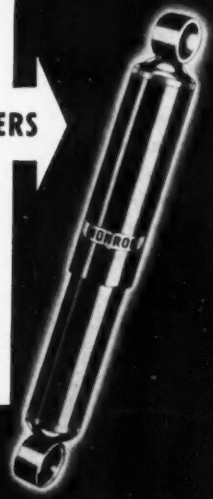
FRED S. DUESENBERG

Fred S. Duesenberg was a master builder of both stock and racing cars who consistently translated the most advanced racing techniques into terms of manufacturing practice. He designed the first American-built straight-8 engine and a car with his name was the first to have 4-wheel brakes. His yen for engine building first manifested itself in the early 1900's when he built a small rotary-valve job to power the service machines in a bicycle shop at Rockford, Iowa, which he operated with his brother, August.

From this beginning came a long line of racing cars that included many Indianapolis winners and the first American car to win the grueling French Grand Prix. Victories of his cars throughout the United States and Europe made Duesenberg famous in racing circles the world over. In 1932, he lost his life in an accident at Ligonier Mountain, Pennsylvania, at the age of 55.

(One in a series of sketches about great automotive industry pioneers.)



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Together with better highways, improved ride control devices have greatly smoothed travel for America's autos, trucks and buses during the last half century. Monroe has pioneered in developing the best ride control products —shock absorbers, sway bars, struts and molded rubber parts. Today, Monroe ride control products are top choice among America's automotive engineers.

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Monroe Shock Absorbers are standard equipment on more makes of new cars than any other brand of shock absorber.

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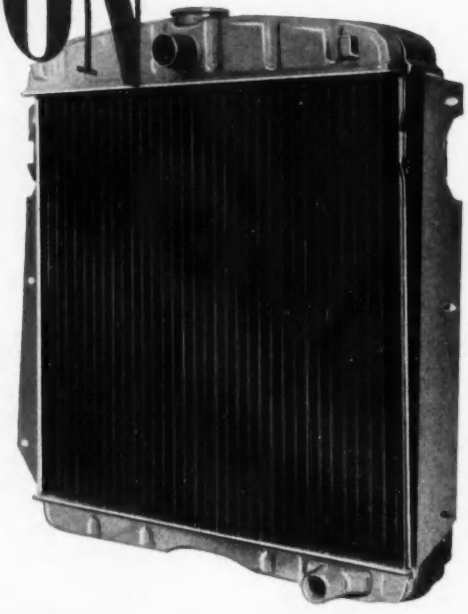
look to

HARRISON



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RADIATORS

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HARRISON RADIATOR DIVISION, GENERAL MOTORS CORPORATION, LOCKPORT, NEW YORK

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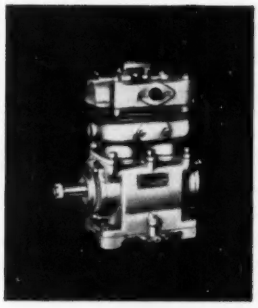
THE WORLD'S MOST TRIED AND TRUSTED

AIR BRAKES

You're looking at . . . the World's Toughest Proving Ground for any Braking System!



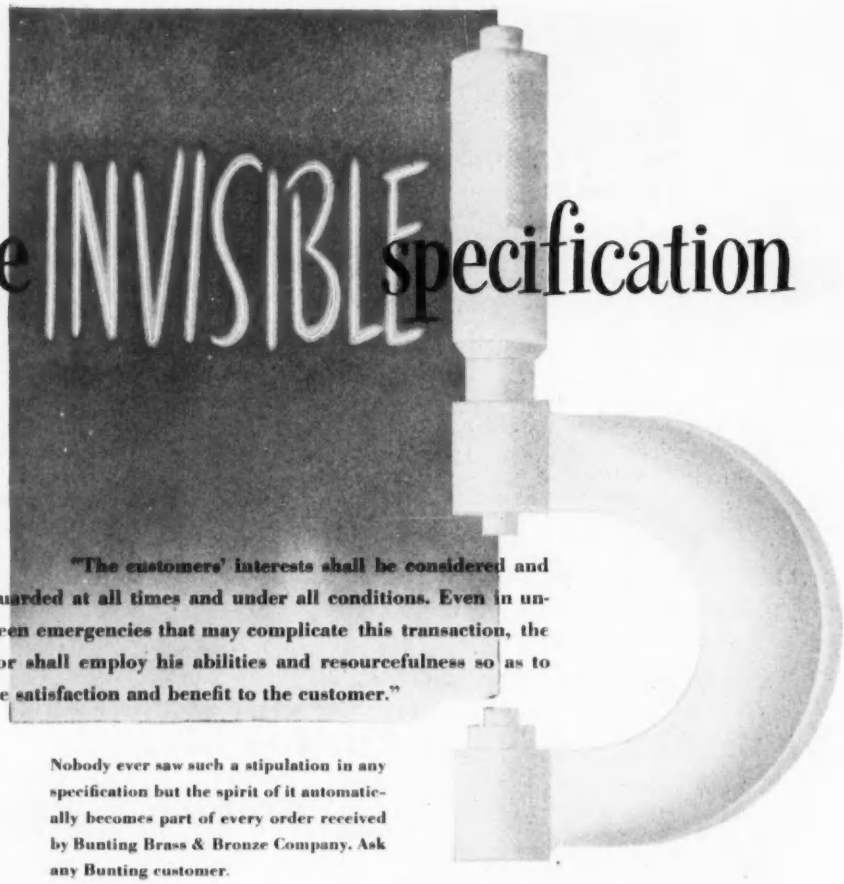
THE BENDIX-WESTINGHOUSE COMPRESSOR —heart of the air brake system—performance proven over more miles on more installations than any other compressor available!

That's right—the bus industry, due to the very nature of day after day city driving . . . **requiring a truly terrific number of braking applications per mile** . . . is recognized as the world's toughest test for any braking system. And over the years the men who build and operate the nation's buses have made Bendix-Westinghouse Air Brakes first choice for this rough and rugged braking chore. But what does this mean to you? It means when you specify Bendix-Westinghouse Air Brakes for your trucks as well as your buses, you specify a **completely proven braking system** ready to deliver full power and performance under any and all driving situations. What's more, it means you specify the world's finest compressor—built on the same **proven reciprocating piston principle** as the engines in your vehicles—with a demonstrated ability to maintain full air pressure under even the most gruelling conditions—for **longest service life at lowest maintenance cost!** Take advantage of it—specify Bendix-Westinghouse, the world's most tried and trusted air brakes!

BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY

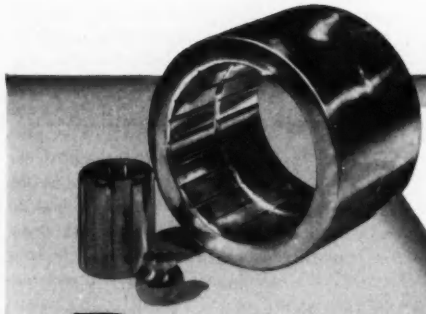
ELYRIA, OHIO BERKELEY, CALIF.

the INVISIBLE specification



"The customers' interests shall be considered and safeguarded at all times and under all conditions. Even in unforeseen emergencies that may complicate this transaction, the vendor shall employ his abilities and resourcefulness so as to insure satisfaction and benefit to the customer."

Nobody ever saw such a stipulation in any specification but the spirit of it automatically becomes part of every order received by Bunting Brass & Bronze Company. Ask any Bunting customer.



The sleeve bearing is not complex in structure; it conforms readily to design requirements; it is easily installed. Cast Bearing Bronze is the most adaptable of all sleeve bearing materials; it possesses excellent anti-friction properties. With proper film lubrication, its coefficient of friction is as low as can be obtained with any other bearing type. A successful Bunting Bronze bearing installation is readily attainable. We ask the opportunity to work with you, and to quote on your requirements.

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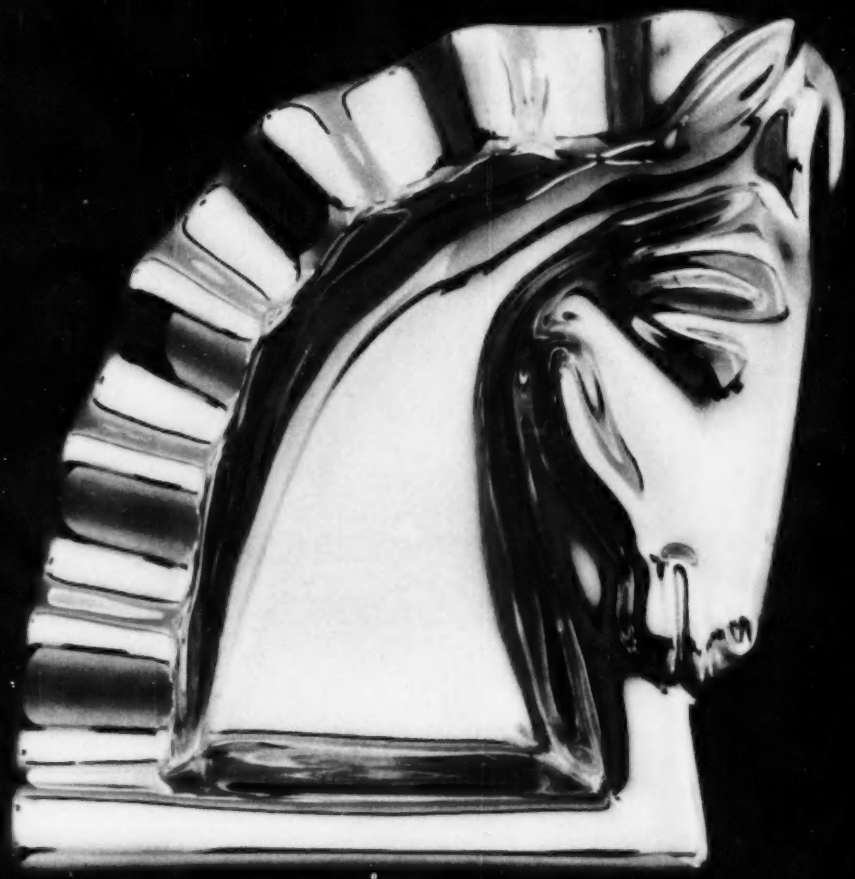
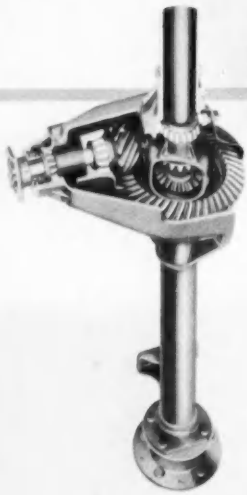


what happens to your horsepower?

From motor to traction point, the horsepower your automotive vehicle generates must travel through a maze of propulsion units. Spicer has concentrated on the invention, development and perfection of these units for 48 years. Today, the use of Spicer equipment for efficient application of horsepower is standard in almost every type of automotive vehicle. Ten great and modern Spicer plants are efficiently equipped to serve the industry's needs.



Spicer

SPECIALISTS IN SERVICE

Standard equipment for over 40 years in many of America's leading automotive vehicles

● This Spicer Salisbury Axle for passenger car and light commercial use is engineered for long, quiet life. It offers these special features:

RIGIDITY—The special Spicer design and construction maintain accurate alignment of gears and bearings under all speeds and loads, assuring continued quiet operation.

LUBRICATION—Scientifically developed control of oil circulation provides a constant, correctly proportioned flow to all gears and bearings for effective lubrication and cooling.

RUGGEDNESS—Sturdily constructed to withstand the high speeds and extremes of punishment which are common in modern automotive vehicle operation.

ACCESSIBILITY—Extremely easy to get into for inspection of parts. Simple-to-remove gear cover, oil level and drain plugs reduce service time and costs.

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Division of Dana Corporation • **TOLEDO 1, OHIO**

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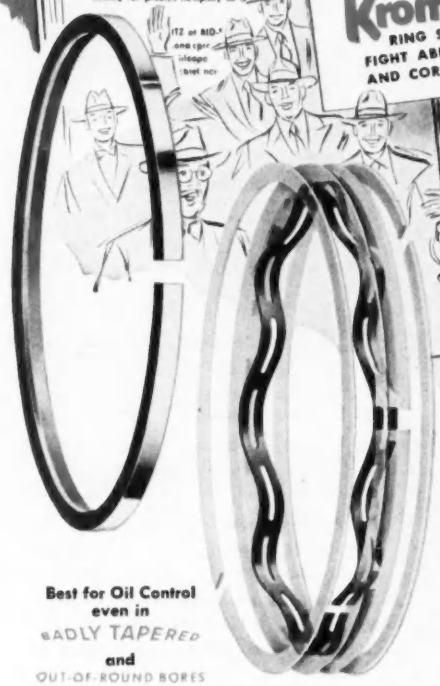
TRANSMISSIONS • UNIVERSAL JOINTS • BROWN-LIPE AND AUBURN CLUTCHES • FORGINGS • PASSENGER CAR AXLES • STAMPINGS • SPICER "BROWN-LIPE" GEAR BOXES • PARISH FRAMES • TORQUE CONVERTERS • POWER TAKE-OFFS • POWER TAKE-OFF JOINTS • RAIL CAR DRIVES • RAILWAY GENERATOR DRIVES

SEALED POWER KROMEX BY A LANDSLIDE!

CHROME CAN TAKE MORE PUNISHMENT

MD-50 STEEL OIL RING



Best for Oil Control even in
BADLY TAPERED
and
OUT-OF-ROUND BORES

Late-Model Cars operate at higher engine speeds, higher compressions, higher combustion temperatures • Chrome can take that kind of punishment • Sealed Power KromeX Ring Sets have solid chrome facing on top compression rings and on side rails of MD-50 Steel Oil Ring • All rings in KromeX Ring Sets are beveled or tapered to thread-line contact for quick seating.

SEALED POWER CORPORATION, MUSKEGON, MICHIGAN

Sealed Power Piston Rings

PISTONS • CYLINDER SLEEVES

MINNEAPOLIS
Sept. 29, through Oct. 1.

MILWAUKEE
Oct. 7, through Oct. 10.

ST. LOUIS
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BUFFALO
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BALTIMORE
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Coming to help you

solve problems in design and production!

"BRINGING the mountain to Mohamet might best describe Dow Corning Corp.'s traveling exhibit . . . Free standing panels . . . separate the exhibit into nine bays, each emphasizing a property of silicones and showing where that property brings a benefit to an actual end product or operating unit . . ."
INDUSTRIAL MARKETING (June 1952)

"NEXT TO THE GREATEST SHOW ON EARTH . . . We could go on . . . reciting the fantastic properties of Silicones, but just as breathtaking as the materials were the display techniques used to demonstrate them . . ."
CIRCUIT RIDER (Vol. 6, No. 2, published by Electrical Construction and Maintenance)

". . . Heat Stability Plus: Visitors . . . see, among other demonstrations, how Silastic (Dow Corning's silicone rubber) remains soft and flexible at temperatures far above the limits of organic rubber . . ."
CHEMICAL WEEK (Jan. 26, 1952)

"IF YOU HAVEN'T already seen it, don't miss it when it comes around . . ."
POWER ENGINEERING (May 1952)

DOW CORNING SILICONES . . . are no longer a mystery or a "future possibility" to the 17,000 executives and engineers, representing more than 4600 plants, who have already seen the Dow Corning Silicone Exposition.*

They learned that silicones are fluids and resins that keep clothes and shoes and brick walls dry in the rain. They're fluids that polish without rubbing.

They're rubber that won't melt on hot aircraft engine cylinders or freeze on switches that operate bomb bay doors at 100° below zero.

They're electrical insulating resins and varnishes that double the power of electric motors, or multiply by 10 the life of electric machines.

They're paints that protect metal at 1000°F. They're foam killers and release agents. They're a whole family of new engineering materials that can help you to improve your product or to cut production costs.

*In Boston • Chicago • Cleveland • Dayton Detroit • Fort Worth • Houston Indianapolis • Los Angeles • New York Philadelphia • Pittsburgh • Seattle Washington, D.C. • or Wichita.

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☐ Minneapolis ☐ Newark
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Actual Tests Prove:

FRAM FILTERS CUT ENGINE WEAR

Bearing Wear Test

There was 95% less metal (by weight) worn from the bearings of the Fram-protected car.

Top Cylinder Bore Wear Test

There was 91% less increase in top bore diameter in the cylinders of the Fram-protected car.

Ring Wear Test

There was 93% less wear (measured by ring gap) on the rings of the Fram-protected car.

Important Notice to Automotive Engineers:

The facilities of the Fram Dust Tunnel are at your disposal for testing and study of operation under severe dust conditions. Write, wire or phone for complete details. FRAM CORPORATION, Providence 16, R. I., *In Canada:* J. C. Adams Co., Ltd., Toronto, Ontario.

IN DEXTER, MICHIGAN, continuing research studies prove significant savings of engine life with the use of improved filter protection under high-concentration dust conditions. The charts above represent results obtained from recent tests using ordinary protection (oil bath air cleaner and no oil filter) and heavy-duty protection (Fram Carburetor Air Filter and Fram Oil & Motor Cleaner with Filcron Cartridge). New engines were used under identical controlled conditions for each phase of testing. Recent road tests and engine stand tests indicate these savings as representative of those obtainable under actual driving conditions. Your engines deserve Fram Protection.

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FRAM OIL & MOTOR CLEANERS ★ FRAM FILCRON REPLACEMENT CARTRIDGES ★ FRAM CEL-PAK REPLACEMENT CARTRIDGES FRAM FILTRONIC REPLACEMENT CARTRIDGES ★ FRAM CARBURETOR AIR FILTERS ★ FRAM GASOLINE FILTERS ★ FRAM CRANKCASE AIR FILTERS ★ FRAM POSITIVE CRANKCASE VENTILATORS ★ FRAM RADIATOR & WATER CLEANERS ★ FRAM FUEL OIL FILTERS ★ FRAM INDUSTRIAL OIL AND FUEL FILTERS ★ FRAM SEPARATOR-FILTER FOR IMMISCIBLE LIQUIDS ★ FRAM CUSTOM-DESIGNED FILTERS FOR SPECIALIZED APPLICATIONS.

FRAM
OIL • AIR • FUEL • WATER
FILTERS

MUSCLES... where you need them

AiResearch actuators are small in size...big in power!

For more than a decade AiResearch actuators have met the operating requirements of every U. S. military and commercial aircraft. They combine top performance with the utmost in dependability.

AiResearch is now producing more than 292 different actuators for specific uses. They meet *every* military specification. Major characteristics are wide operational ranges in temperature, light weight, and long life. Each type of unit has the unique ability, proven in AiResearch laboratories, to withstand 17 critical environmental conditions of flight. Other unique design features, such as integral motor brakes and torsion bar positive stops, have made AiResearch actuators the leading performers in this field.

AiResearch invites you to submit your special engineering problems for our consideration.

Would you like to work with us? *Qualified engineers, scientists and skilled craftsmen are needed now at AiResearch in both Los Angeles and Phoenix.*

AiResearch Manufacturing Company

A DIVISION OF THE GARRETT CORPORATION

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AiRESEARCH—specialists in the design and manufacture of aircraft accessories in the following major categories: air turbine refrigeration • cabin superchargers gas turbines • pneumatic power units • electronic controls • heat transfer equipment • electric actuators • cabin pressure controls and air valves

How a

"talk in time"

reduced the cost of an engine!

A large midwestern manufacturer of farm machinery was designing an engine. Things were pretty well settled and production schedules were set up. Right about this time I called on the Company and had a chat with the President. When he showed me the blueprints, I immediately saw how a casting, with which we had considerable experience, could effect a substantial economy. After a few minutes figuring I said, "We can make a casting that can save you real money." Although dubious, the President called in his engineers. We talked—analyzed—sketched. I suggested a test casting be made immediately. It was—it proved successful. Today every one of that Company's engines has this casting—and every engine costs less!

I am a Campbell, Wyant and Cannon Sales Engineer. I can offer you the same service—but don't wait until I call—call me!

CAMPBELL, WYANT AND CANNON
FOUNDRY COMPANY

Muskegon, Michigan • Telephone: Muskegon 3-1331

CWC

Since 1908

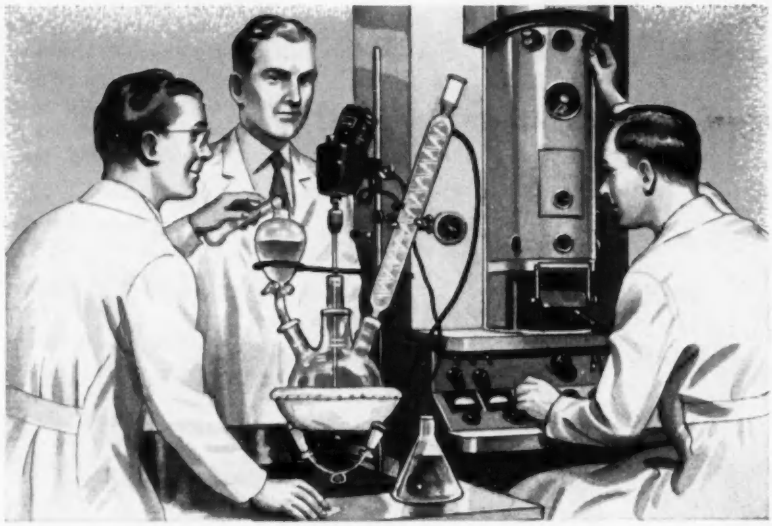
METALLURGICAL ENGINEERING provides unlimited possibilities in product design

PRECISION CONTROL assures the desired casting

MECHANIZATION to produce castings at reasonable cost

Constant Firestone Research Brings You Safer, Longer-Wearing Tires

This line would appear to be a mile long, (magnified 100,000 times) if it were possible to view it through Firestone's Electron Microscope, shown at right.



This, and other ultra modern equipment in Firestone's multi-million-dollar Research Laboratory, delve into the deepest mysteries of science to assure you of the safest, longest-wearing tires that money can buy.

LOOK TO Firestone FOR GREATEST SAFETY, SERVICE, ECONOMY

Such major advancements in tire construction as:

Gum-Dipping — to eliminate internal heat and friction, the greatest enemies of tire life.

Safti-Lock Cord Bodies — to provide racing tire construction in the passenger tires you use — the strongest and safest known.

Safti-Grip Tread — Thousands of non-skid angles, plus skid resisters, molded into continuous running strips to give better braking power and longer wear.

These are the safety and economy features which represent greater safety and service to you. See your Firestone Dealer today.

YOUR SAFETY IS OUR BUSINESS AT FIRESTONE

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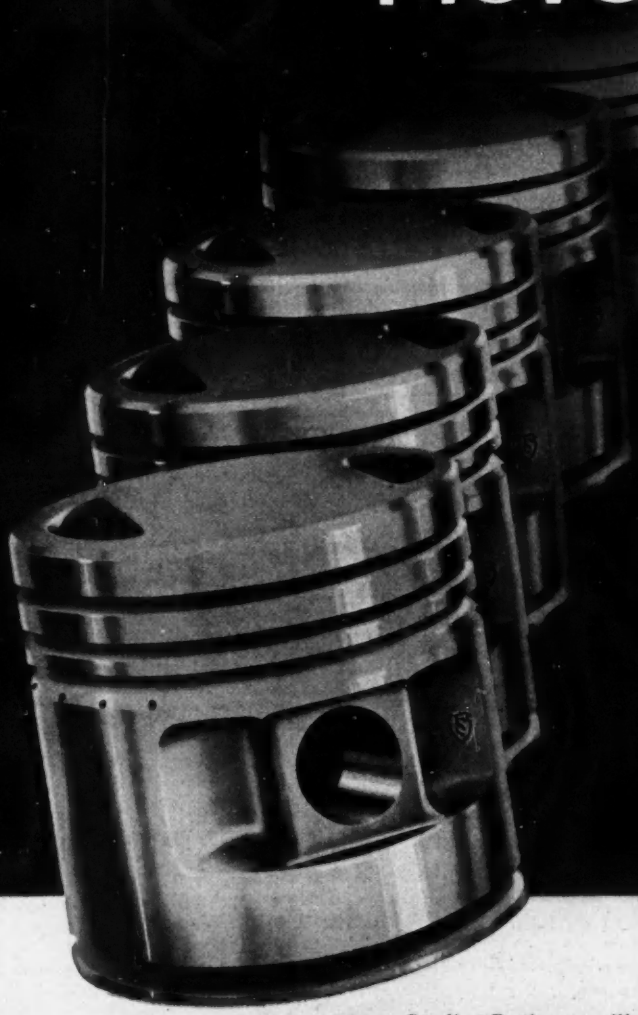
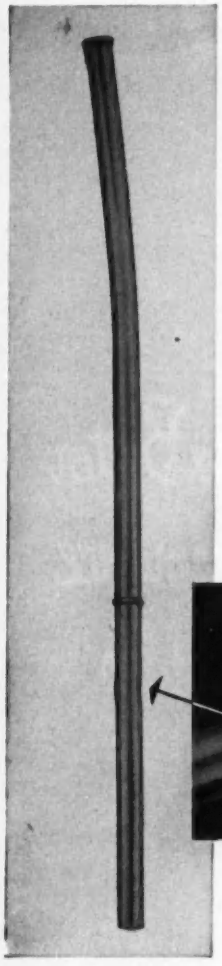
STERLING
PISTONS

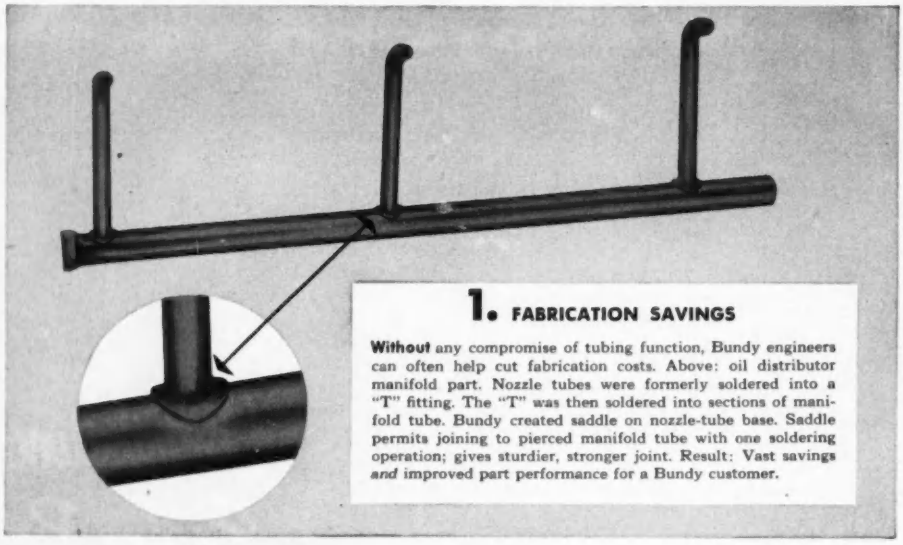


Contributing to Better Engine Performance for Over 30 Years

Sterling Engineers will work with you as they have with other leading manufacturers in developing pistons to meet your exacting requirements. Write or phone.

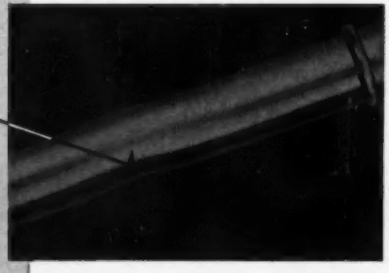
Your greatest automotive





1. FABRICATION SAVINGS

Without any compromise of tubing function, Bundy engineers can often help cut fabrication costs. Above: oil distributor manifold part. Nozzle tubes were formerly soldered into a "T" fitting. The "T" was then soldered into sections of manifold tube. Bundy created saddle on nozzle-tube base. Saddle permits joining to pierced manifold tube with one soldering operation; gives sturdier, stronger joint. Result: Vast savings *and* improved part performance for a Bundy customer.



2. DESIGN SAVINGS

It is Bundy policy to do everything possible to meet a customer's specifications. But frequently Bundy men can find a way to redesign a part at considerable savings. Above: oil dip stick tube. Customer specified expanded tube diameter below upset to assure press fit in crankcase. After examining drawings, Bundy engineers suggested cheaply made offset bend below upset. Offset provides effect of press fit without expense. Too, Bundy suggested slight bend above upset to keep dip stick from rattling. Customer received a better functioning part produced at lower cost.

Bundyweld Tubing®

DOUBLE-WALLED FROM A SINGLE STRIP

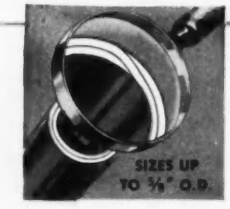
WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and

passed through a furnace. Copper coating fuses with steel. Presto . . .

Bundyweld, double-walled and brazed through 360° of wall contact.



← **NOTE** the exclusive patented Bundyweld beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.

Bundy Tubing Distributors and Representatives: *Cambridge 42, Mass.:* Austin-Hastings Co., Inc., 226 Binney St. • ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 W. 47th Place • ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 • ***Philadelphia 3, Penn.:*** Rutan & Co., 1717 Sansom St. • ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.:*** Eagle Metals Co., 4755 First Ave. South ***Toronto, Ontario, Canada:*** Alloy Metal Sales, Ltd., 181 Fleet St., East • **Bundyweld nickel and Monel tubing is sold by distributors of nickel and nickel alloys in principal cities.**

tubing buy on every count

Choose Bundyweld Tubing and you buy *proved*, safe performance; unmatched tubing features; engineering skills that make "impossible" parts possible and cut costs at every turn. *Look* at all you buy in Bundyweld Tubing:

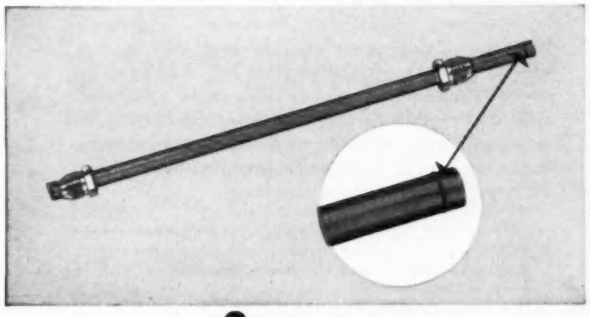
You buy priceless, safe tubing performance, proved in billions of miles traveled by millions of trucks, cars, buses and tractors with brake lines of Bundyweld Tubing. In the last 20 years, over two billion feet of Bundyweld have been used in those brake lines alone.

You buy unmatched tubing features. Bundyweld is the *only* tubing double-walled from a single strip with beveled edges. Its extra-strong steel walls are copper-brazed through 360° of wall contact. On the job, Bundyweld sails past shock, stress, strain. It has high endurance limit. It's leakproof. In production, Bundyweld goes through its paces without balking, bends easily, machines easily, handles easily.

You buy unsurpassed engineering skills. Many Bundy customers bring design problems to Bundy engineers; get simpler, cost-saving, tubing-part designs — *without* any compromise in function. If a customer wishes, Bundy will take over complete fabrication of a part — turn it out in large quantity, with an eye on accuracy and cost. Whether you need tubing in lightweight, easy-handling lengths for fabrication yourself, whether you need design or fabrication help, or whether you need fast delivery of finished parts, Bundy is equipped to answer your needs.

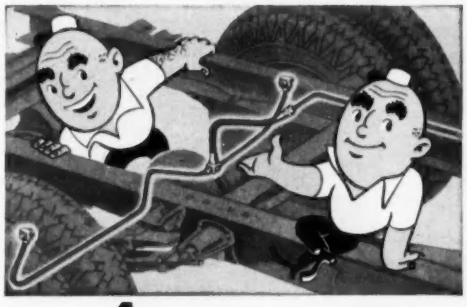
Whether they think of cost or performance — or both — the world's finest automotive engineers know there is no adequate substitute for Bundyweld Tubing — or Bundy skills.

Contact a Bundyweld Distributor (listed lower left), or write direct to *Bundy Tubing Company, Detroit 14, Michigan*



3. COST SAVINGS

Bundy leaves no stone unturned in search of ways to cut costs. For instance, Bundy fabricates simple truck fuel-line part above (of tinned Bundyweld). Customer wanted part shipped with sleeve-type compression fittings mounted on it. Bundy added small, non interfering fin to each part end. Result: Fin keeps fittings from sliding off tubing part during shipping and subsequent handling, eliminates otherwise expensive packaging, eliminates cost of remounting fittings that would have slipped off.



4. PERFORMANCE SAVINGS

You save because of Bundyweld's safe, sure performance during the life of your trucks, cars, buses, tractors, or other automotive equipment. *Priceless* performance delivered at lowest cost consistent with Bundyweld quality. *Proved* performance delivered in fuel, oil, and brake-line systems of 95% of today's cars—fine testimony to Bundyweld reliability.

RYAN

Aircraft and Aeronautical Products

Leaders in High-Temperature Metallurgy

for

JET, PISTON AND ROCKET ENGINES

In fabricating stainless steel and other heat- and corrosion-resistant alloys, Ryan's leadership has been established by proved techniques and long experience in this specialized field. With ceramic coating, continuous metallurgical research, and development of new alloys, Ryan is extending its research toward substitution of less critical materials for jet, piston and rocket engine components.

Typical of Ryan's high-temperature developments is this ceramic-coated exhaust system for Boeing Stratocruisers. The first company to put ceramic-coated engine parts into production, Ryan has proved they are highly successful in inhibiting corrosion and carbon absorption, thereby extending service life. Now ceramic coatings are available for jet engine components, too.

Ryan SINCE 1922

Metal Products Division • Jet Engine Components • Exhaust Systems • Rocket Assemblies

RYAN AERONAUTICAL COMPANY • LINDBERGH FIELD • SAN DIEGO, CALIF.

Serving the automotive industry...

U.S. Rubber's Plastics Center

Practically every plastic known to science is molded and extruded at the United States Rubber Company's Chicago Die Mold Plant.

Here, serving the automotive industry and original equipment manufacturers, are research technicians and engineers who work unceasingly at improving and making better plastics. They study operating requirements, anticipate new developments, compound new types of plastics.

For example, two of the remarkable plastics developed by "U.S." technicians are Uscolite and Enrup. Uscolite has such high impact strength that it easily withstands a .44 calibre revolver bullet fired from 20 yards. **Lightweight and amazingly versatile,** it retains unusual toughness at temperatures as low as −40° F., yet remains rigid and dimensionally stable at temperatures as high as 170° F.

Enrup can be made as flexible as soft rubber, or as rigid as hard rubber. Both Uscolite and Enrup are resistant to most chemicals and have excellent dielectric properties.

A "U.S." Automotive Sales Technician will gladly assist you in selecting the right type of plastic for your product or application. And remember that, in addition to their own skill and research data, **these technicians have at their command the entire resources of the nationwide chain of plants and laboratories which comprise the United States Rubber Company.**

PRODUCTS OF

U.S. RUBBER
SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

For versatility in **FORCE MEASUREMENT**

use the HAGAN

air-operated THRUSTORQ

The Hagan THRUSTORQ translates a force or weight into a pneumatic signal pressure. This pressure reports the force or weight accurately and dependably to indicating or recording instruments, or to an automatic control system.

Some typical applications of Hagan THRUSTORQ include:

- testing piston rings
- jet engine thrust measurement
- rocket thrust measurement
- spring testing machines
- automatic batch weighing
- dynamometer testing of electric motors, hydraulic pumps or internal combustion engines

HAGAN THRUSTORQ
measuring thrust and torque *with air!*

HAGAN
HALL
BUROMIN
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For information about the application of Hagan THRUSTORQ to your particular problems, write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

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As a source of large volume and difficult mechanical springs, Eaton Spring Division offers the most modern of spring production facilities plus a background of more than twenty years in this specialized field. Consulting with Eaton Spring engineers often leads to simplification and worthwhile economies in spring requirements.

EATON MANUFACTURING COMPANY

General Offices: CLEVELAND, OHIO

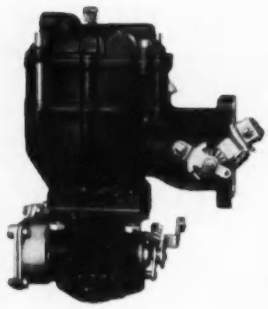
Spring Division

9771 FRENCH ROAD • DETROIT 13, MICHIGAN

Will he Buy Your Truck Next Time?

IT ALL DEPENDS ON PERFORMANCE and PERFORMANCE DEPENDS ON

Zenith CARBURETORS



No manufacturer could long exist in the competitive commercial vehicle field without drawing heavily on previous owners for new vehicle sales. It is perfectly obvious, no owner would buy the same make vehicle again and again unless it has delivered satisfactory performance. Therefore, it is just good business to see that every component contributes its share toward building owner loyalty. That's why manufacturers whose vehicles are Zenith* equipped measure carburetion costs in lasting terms rather than initial expense. In the field of heavy-duty carburetion, one name, Zenith, has stood for lasting satisfactory performance for over a quarter of a century. Zenith's rugged construction, strong idling, freedom from stalling and response to every demand make it the engineers' choice. For good will, it's good business to specify the best—Zenith for lasting performance.

*REG. U.S. PAT. OFF.

ZENITH CARBURETOR DIVISION OF
696 Hart Avenue • Detroit 14, Michigan

Bendix AVIATION CORPORATION

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

announcing VICKERS

BALANCED VANE TYPE

HYDRAULIC MOTORS

SIMPLE DESIGN - RUGGED CONSTRUCTION

AUTOMATIC WEAR COMPENSATION THROUGHOUT MOTOR LIFE

HYDRAULIC BALANCE MEANS LONGER LIFE AND LESS MAINTENANCE

CONTINUOUS DUTY RATINGS TO 26 HP

GREATER ADAPTABILITY

(Above) Series 200 Vickers Hydraulic Motors available in two sizes with flange or foot mounting.

(At Right) Series 500 Vickers Hydraulic Motors available in two sizes with flange or foot mounting.

COMPACT - LOW WEIGHT

EXCLUSIVE "ROCKING BEAM" CONSTRUCTION

DYNAMIC BALANCE AND QUIET OPERATION

COMPANIONS TO VICKERS BALANCED VANE TYPE PUMPS

Two series of Vickers Balanced Vane Type Hydraulic Motors are now in production. They offer many advantages for the economical and efficient application of variable speed rotary mechanical power to machine tools, industrial machinery and mobile equipment. Some of their important features are mentioned above; for further information get in touch with your nearest Vickers Application Engineering Office.

Write for NEW Bulletin M-5102

VICKERS Incorporated

DIVISION OF THE SPERRY CORPORATION

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Application Engineering Offices: **ATLANTA • CHICAGO (Metropolitan) • CINCINNATI • CLEVELAND • DETROIT HOUSTON • LOS ANGELES (Metropolitan) • NEW YORK (Metropolitan) • PHILADELPHIA (Metropolitan) • PITTSBURGH ROCHESTER • ROCKFORD • ST. LOUIS • SEATTLE • TULSA WASHINGTON • WORCESTER**

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

4035

"Special-purpose electrical equipment" is much more than just a name at Delco-Remy. For example, take a look at this heavy-duty marine generator. From end to end, inside and out, it is engineered and manufactured to do a special job especially well.

And check the list of important Delco-Remy marine generator features—keyed to the illustration—to see some of the many extra steps taken to insure long, dependable, trouble-free service and top performance under all operating conditions.

The outstanding record of Delco-Remy marine electrical equipment is no accident. All marine units are exactingly designed and built to meet the rigorous demands of marine service. They represent "special-purpose equipment" in the fullest meaning of the term.

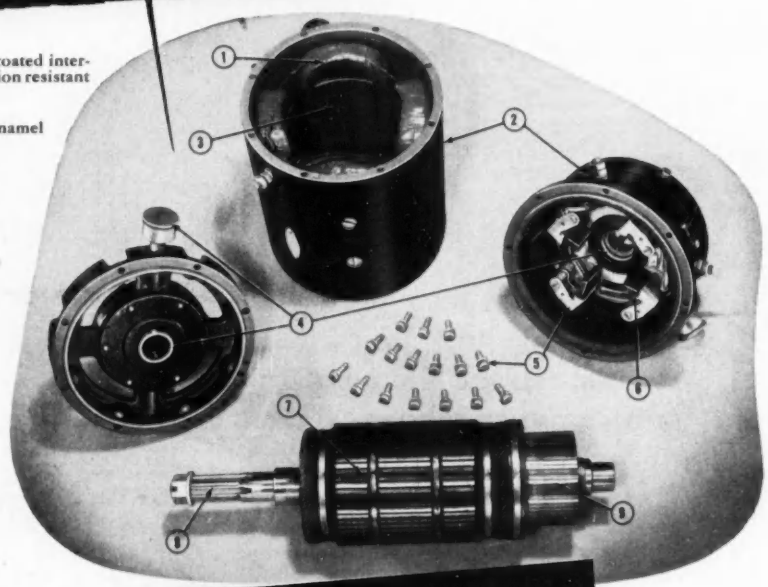
Why it pays to consider

DELCO-REMY

for

SPECIAL-PURPOSE ELECTRICAL EQUIPMENT

This Delco-Remy special marine generator gives you *all* these great features!



1. Frame and field assembly coated internally with moisture and corrosion resistant synthetic resin.

2. Durable, long-life baked enamel finish on external surfaces.

3. Laminated pole shoes for greater efficiency.

4. Ventilated cast iron end frames, with heavy-duty ball bearings. Grease cups provide easy, direct lubrication.

5. Extra-heavy corrosion resistant plating on brush rigging and cap screws in end frame assembly.

6. Large size multiple brushes. Brush rigging adjustable for brush position.

7. Armature extra-dipped and banded for greater durability.

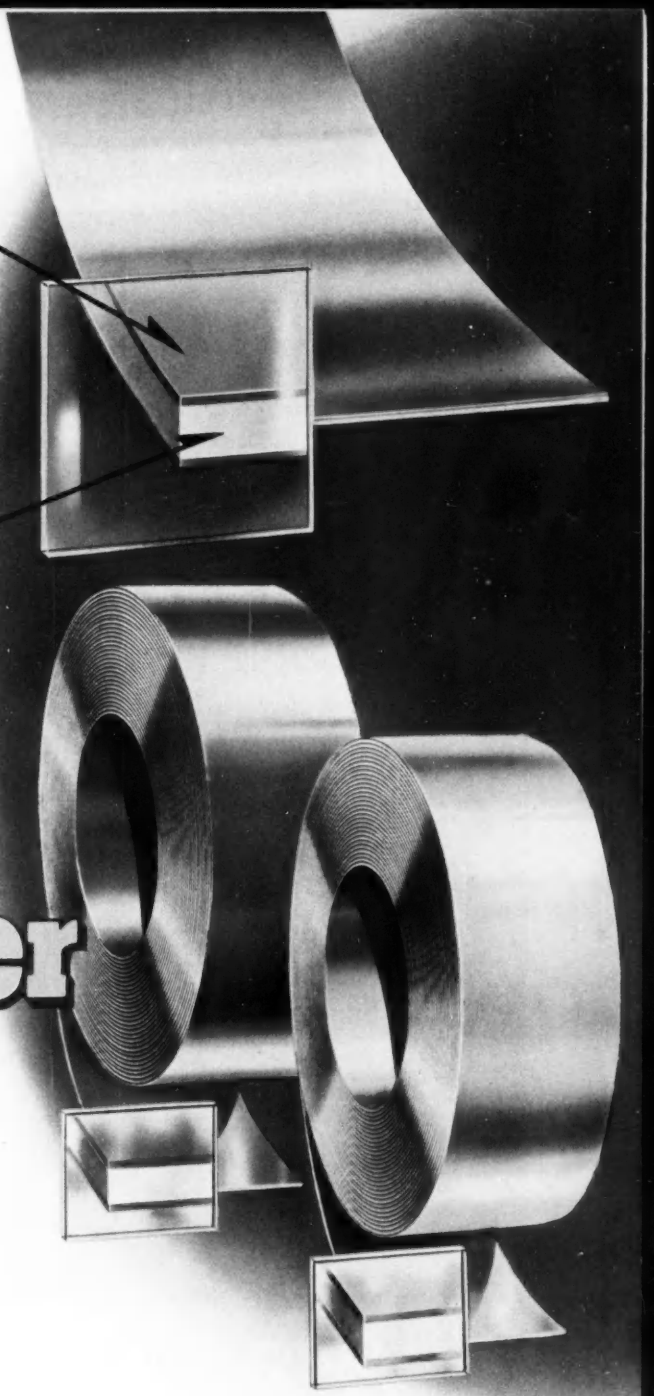
8. Armature shaft splined—gives no-slip drive under heavy loads.

9. Extra-wide, large diameter commutator handles high outputs safely, increases brush life.

Delco-Remy
DIVISION, GENERAL MOTORS CORPORATION
ANDERSON, INDIANA

AUTOMOTIVE, TRACTOR AND MARINE ELECTRICAL EQUIPMENT

All copper (or brass) where you need it- -and steel where steel serves best



SuVeneer®

CLAD METALS

SuVeneer Clad Metals give you *surfaces* of genuine solid copper or brass, to do the jobs for which you ordinarily specify these materials . . . with the big new plus of *steel* for greater strength, twice the elasticity, and lighter weight, than either copper or brass used alone. • You save critical metals for defense—you benefit your products' performance—when you specify time-proved **SuVeneer** Clad Metals. *Let us work with you!*

Superior Steel
CORPORATION
CARNEGIE, PENNSYLVANIA

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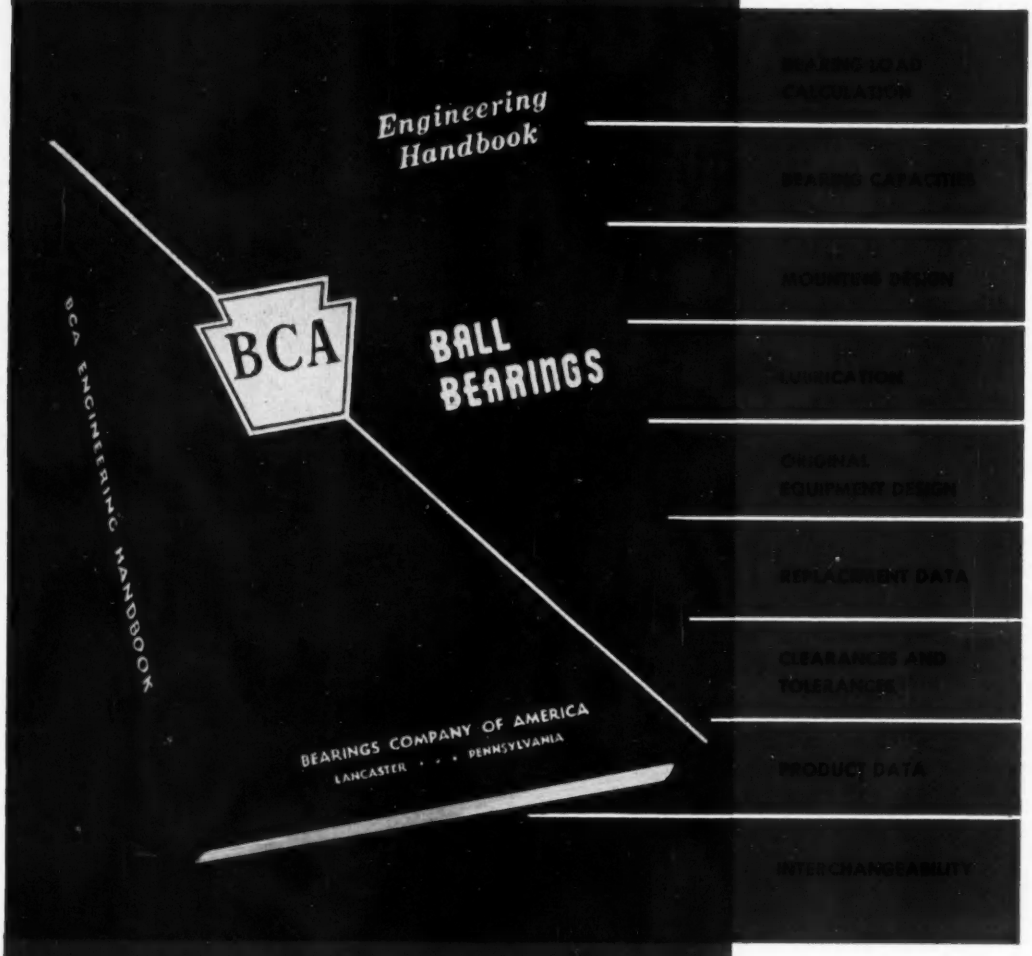

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BCA

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511 Harrisburg Ave.
LANCASTER, PA.

BCA Radial, Thrust, Angular-Contact
BALL BEARINGS

Tailor-made fasteners DESIGNED AND PRODUCED IN VOLUME
by the WORLD'S LEADING SPECIALISTS
in SPECIAL FASTENERS AND ALLIED DEVICES

United-Carr's design and production engineers have years of specialized experience in the field of fasteners. United-Carr's plants are equipped for volume production of metal stampings for the assembly of metal or plastic and ceramic components. Call in United-Carr and you have at your command an integrated team capable of meeting practically any requirements for special fasteners and allied devices.

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CAMBRIDGE 42, MASSACHUSETTS

MAKERS OF DOT FASTENERS

Standard

Locknuts and Lockwashers help keep our modern tanks running longer! But regardless of the application—from tanks to machine tools—endurance and precise locking assure long, efficient bearing assembly life. Skilled craftsmanship plus modern testing is the guarantee of Standard quality.

Standard size locknuts and lockwashers are shipped from complete stocks, and requests for quotations on special locknut and lockwasher sizes receive prompt attention. All orders receive prompt delivery service.

Remember, when *YOU* need locknuts and lockwashers . . . *YOU* need Standard!

Write today for Standard's detailed Bulletin No. 29.

STANDARD **Locknut and Lockwasher, Inc.**
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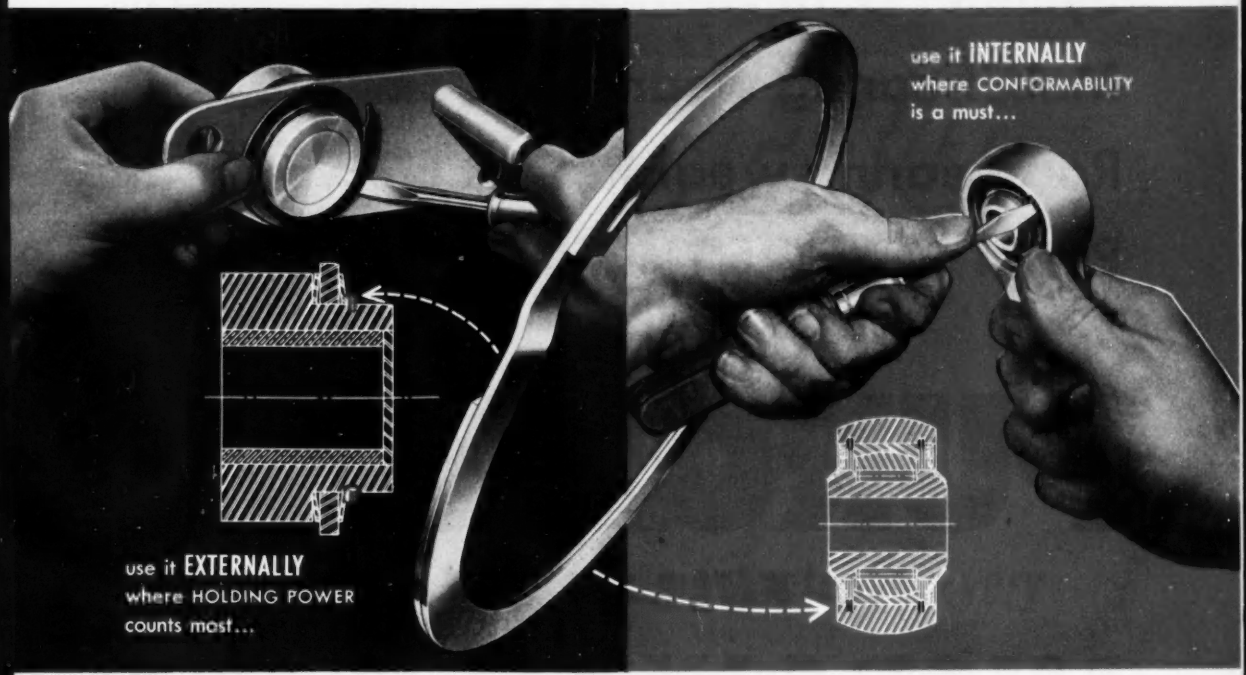
there are hundreds of ways in which Industry uses **SPIROLOX** to solve retaining problems



use "easy-in, easy-out" Spirolox for compact design, removal of trouble-spots, elimination of costly machining and awkward parts!

The two application pictures above show how simply and effectively cylindrical parts assemblies are positioned and locked by Spirolox Retaining Rings in a toggle joint (right) and a friction clutch (left). Installed externally or internally, there's bearing surface all around . . . Spirolox conforms to the groove perfectly to resist centrifugal forces to a higher degree, and resist thrust forces up to its shear strength. In fact, because of its unique two-turn coil design, Spirolox will not jump the groove. Spirolox *stays put* because opening and closing force is resisted by friction created between the two turns. In operation, they are actually "squeezed" together to form a "friction lock!"

In addition to its remarkable stay-put characteristics, Spirolox Retaining Rings provide many advancements which every manufacturer wants. They make machines simpler, lighter, more compact. They eliminate costly machining as well as such old-fashioned fastening methods as keys, pins and collars. They spiral into their grooves easily, saving time and labor in manual installation. They adapt readily to fixtures for automatic production line installation. They provide a uniform shoulder, without gaps or breaks to interrupt a uniform circumference . . . without lugs or projections to create weak spots. These retaining rings stay put, yet they come out again at the flip of a screw driver, ready for re-use . . . a great advantage when assemblies are serviced in the user's hands.

FREE SPIROLOX SPECIFICATIONS CATALOG may help you build a product of greater simplicity and greater sales appeal, by eliminating awkward features and trouble spots. Your copy is waiting to point out how your retaining applications can be handled surer, quicker, more economically with SPIROLOX! Address request for your complimentary Spirolox Specifications Catalog to Ramsey Corporation, St. Louis 8, Mo.

Spirolox Retaining Rings are covered by United States Patent No. 2,450,425 and Foreign Patents. Other patents pending.

R3650

gapless • concentric • requires no special tools • easy-in, easy-out • re-usable • stays put

Cylinder bore wear REDUCED . . 84.6%

Main bearing wear REDUCED . . 77.9%

Rod bearing wear REDUCED . . . 93.3%

Piston wear REDUCED 78.4%

with

PUROLATOR

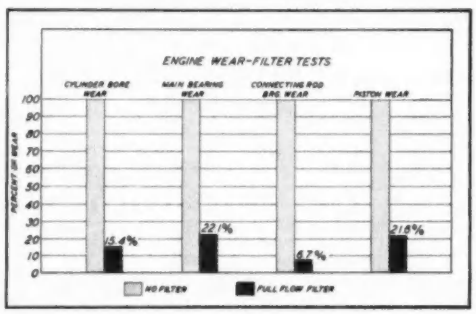
FULL-FLOW

MICRONIC FILTERS

THESE ARE THE RESULTS of tests just completed by one of the world's largest automobile and engine manufacturers.

The purpose of these tests was to determine how much the Micronic Full-Flow element reduces wear.

Running standard gasoline engines under extremely adverse conditions, test engineers found that Purolator Micronic* Full-Flow filtration was the best of all tried . . . far superior to any partial-flow filter.



The secret of this amazing performance is the Purolator* *Micronic* Filter Element with *ten times* the filtering area of old-style filters. It is the *only* element capable of delivering full-flow rates during its entire service life, with effective, dependable filtration down to *microns* (0.000039 in.)!

Purolator's Engineering Department will gladly cooperate in helping you adapt super-efficient Purolator Micronic Full-Flow filtration to your own requirements. *Just write!*

*Reg. U. S. Pat. Off.

PUROLATOR PRODUCTS, INC.
Rahway, New Jersey and Toronto, Ontario, Canada
Factory Branch Offices:
Chicago, Detroit, Los Angeles

PUROLATOR
MICRONIC OIL FILTER
"FIRST IN THE FIELD OF FILTERING"

STROMBERG

CARBURETORS

Performance

Is a Prime Factor in Every Automobile Sale!

Engine performance not only influences *today's* customers, it also builds a reputation which effects *future* sales. Thus, it is doubly important to specify engine components that will maintain your standards of quality and service. In carburetors that means Stromberg.

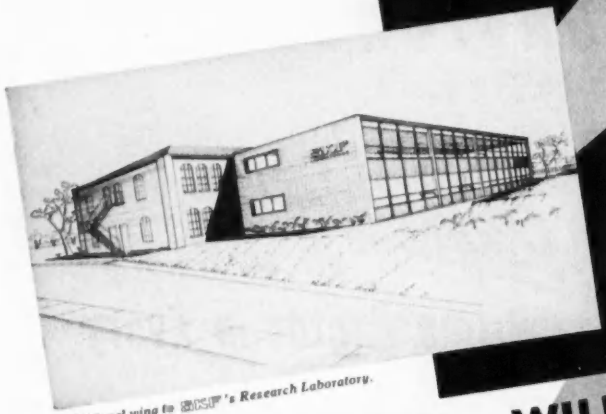
Exclusive design features, and mechanical simplicity have made Stromberg* Carburetors famous for *lasting performance*. Judge on the basis of *long-range economy* and you will agree—Stromberg Carburetors are the logical choice.

*REG. U. S. PAT. OFF.

ECLIPSE MACHINE DIVISION OF Bendix AVIATION CORPORATION

- Standard Equipment Sales: Elmira, N. Y.
- Service Sales: South Bend, Ind.

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.



Additional wing to SKF's Research Laboratory.

READY... WILLING... AND ABLE

In long association with the aircraft industry, SKF has worked closely with power plant engineers in designing and manufacturing anti-friction bearings with stamina to withstand the tremendous punishment dealt them by supersonic aircraft. To continue to help all industries put the right bearing in the right place, SKF has doubled its laboratory area. SKF's expanded research facilities are another step in turning bearing problems into bearing progress! It's all a part of SKF's relentless program of working for ever-higher quality standards—setting the pace for bearing manufacturing.

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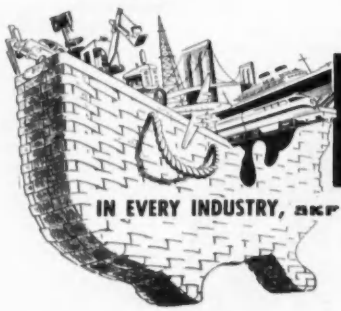

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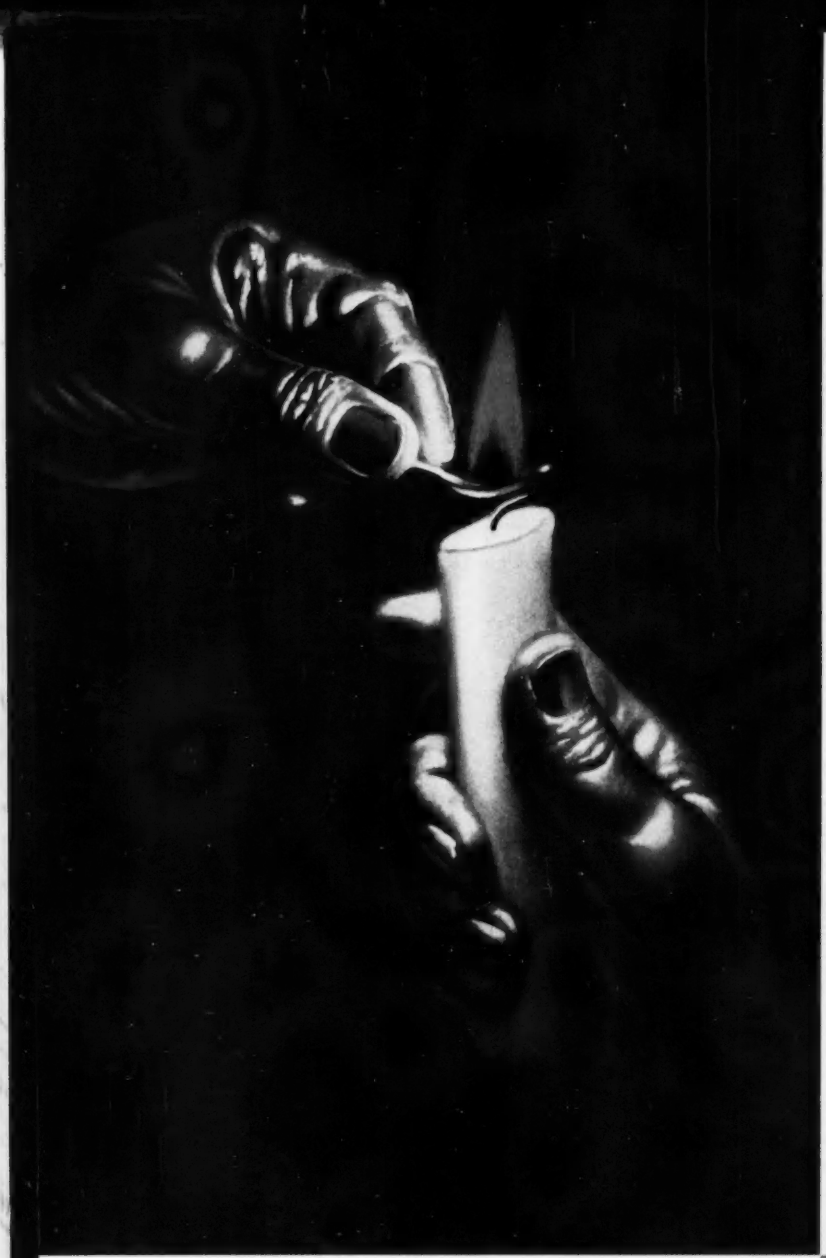

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a single candle
can light the way?

Why lose freedom
when a single vote
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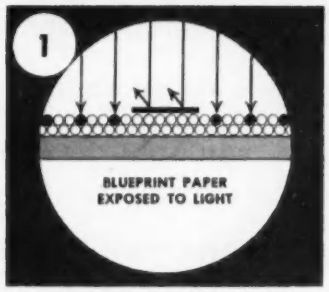
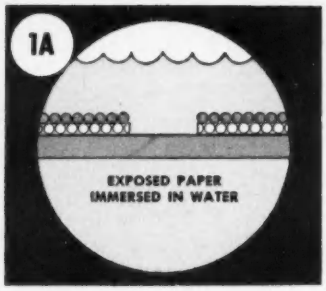
Why is a blueprint



Simplified diagram of enlarged cross section of blueprint paper shows surface particles of the coating being struck by light. The coating, which is pale in color, contains two soluble ferric salts: a cyanide complex and an organic acid. Light reduces some of the ferric to ferrous ions in the exposed areas, producing a mixture of both. Opaque lines in a superimposed drawing prevent the light from reaching the coating beneath, as shown by the black bar in the center.



In the presence of water, the ferrous ions in the exposed areas react with the cyanide complex to form a ferrous-ferricyanide, which *is* Prussian Blue. (This is the famous blue pigment, insoluble in water, discovered in Berlin in 1704.) The areas that were shielded from light contain only the original soluble salts. These are washed away by the water, exposing the white paper beneath. The print then has white lines on a blue background.

Contrary to ordinary photographic processes, moderate overexposure of a blueprint has two good effects. It permits light to penetrate beneath the surface of the coating and thus to act in depth. It also reduces more of the surface salts from the ferric to ferrous condition, including the cyanide complex. But carried to an extreme, overexposure causes light to penetrate the opaque lines of a drawing with a resultant loss of contrast in the developed print.

BLUE?

When a moderately overexposed print is immersed in water, the ion mixtures react together. However, the colorless ferrous compounds that are formed on the surface of the coating cover up the layers beneath, and tend to hide the Prussian Blue color which has formed in the bottom layers. The print, at this stage, will have a grayish cast without full contrast.

Nearly every blueprinter, after washing the prints, immerses them in a solution of potassium dichromate, or peroxide. These are oxidizing agents that reverse the effect of too much light, changing a proportion of the ferrous ions back to ferric ions. In this way, with the help of overexposure, the entire thickness of the coating can be made effective in forming Prussian Blue. A deep, rich blue, contrasty print results.

● As one of the oldest reproduction processes, blueprinting has undergone little development until recent years. CHALLENGE* blueprint papers embody every valuable advance made in this time and, in addition, are produced with the extra skill and care that go into all K&E products. The presence of more colloidal Prussian Blue, plus a pre-coating process, enable CHALLENGE papers to provide more vivid white lines against a background of deeper, more intense blue.

Other outstanding K&E reproduction materials include HELIOS† dry developing diazo papers, cloths and films; ONYX* moist developing diazo papers; MADURO† brownprint papers and cloths; DUPRO† reproduction tracing cloth; and PHOTACT† reproduction papers, cloths and films. Ask your K&E Distributor or Branch for full information on what these various K&E reproduction materials can do for you.

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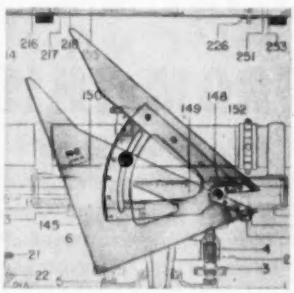
For new ease in measuring straight, curved or irregular lines on maps, plans and charts use one of these precision built Plan and Map Measures. You can take off quantities with them and, with the models calibrated to ¼" or ⅛" scale, you can read distances directly in feet. Instantly re-set to zero by pressing the stem.



A triangle that gives you a straight edge that can be set at any angle! The TRI-TRACTOR*, basically a right triangle, also has a protractor element calibrated in half degrees. Its hypotenuse can be fixed at any desired angle with respect to the base line. Made of transparent plastic. Comes with 8" or 10" base.

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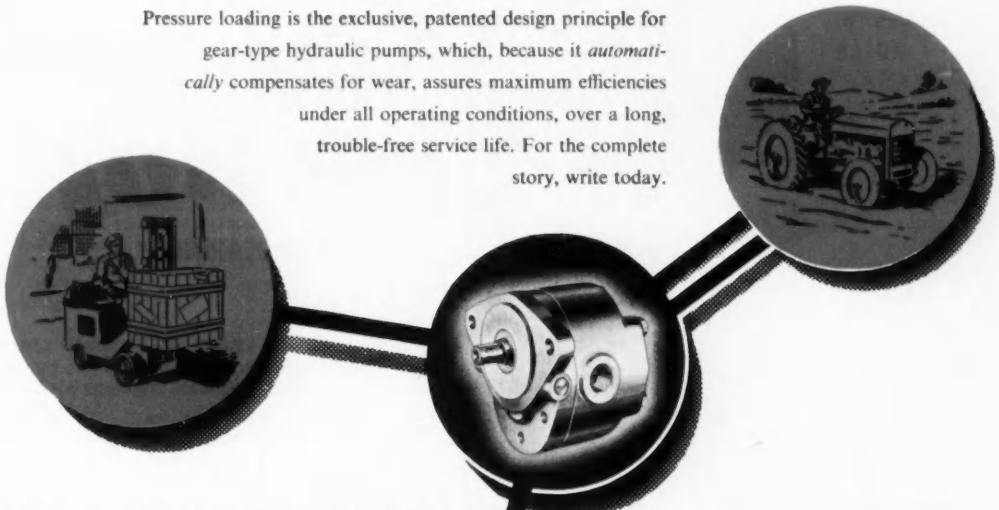

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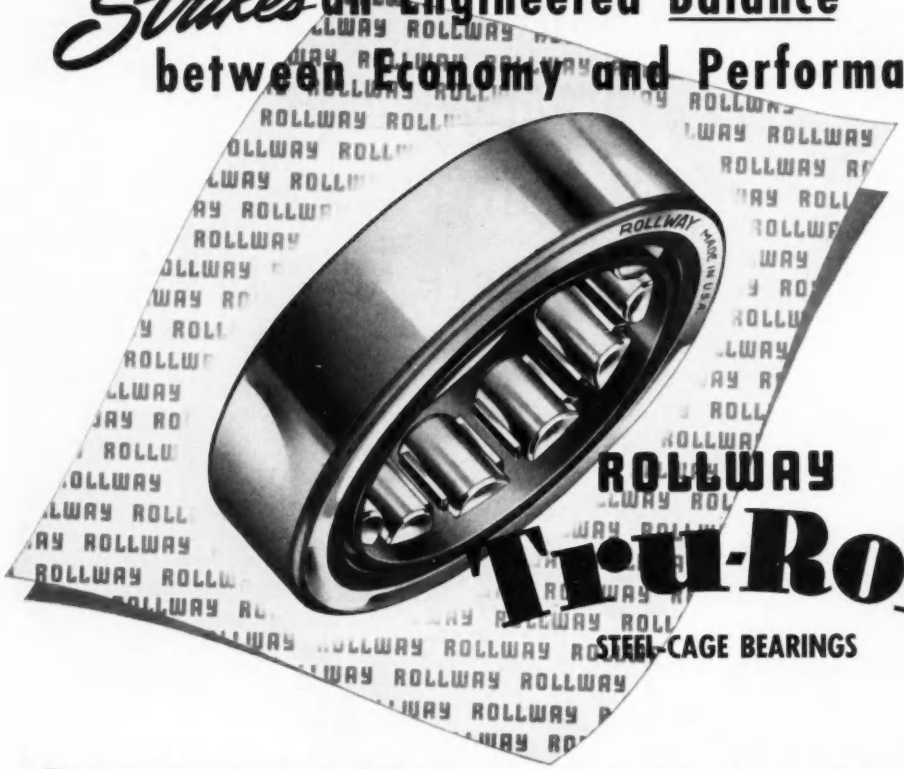

DESIGNED for good performance under reasonable limits of life expectancy, load capacity and cost requirements, the Rollway TRU-ROL is actually a better buy for normal, non-critical applications. *It is especially important where cost is a determining factor.*

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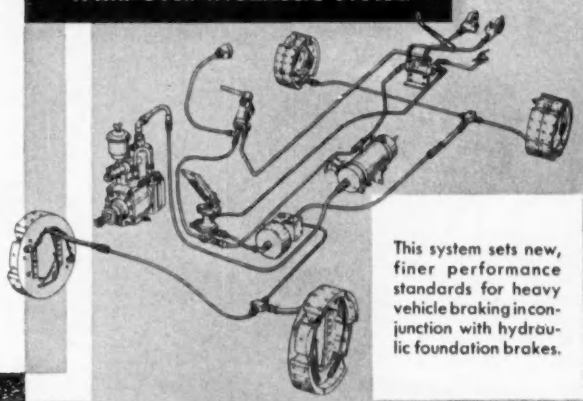

This system sets new, finer performance standards for heavy vehicle braking in conjunction with hydraulic foundation brakes.

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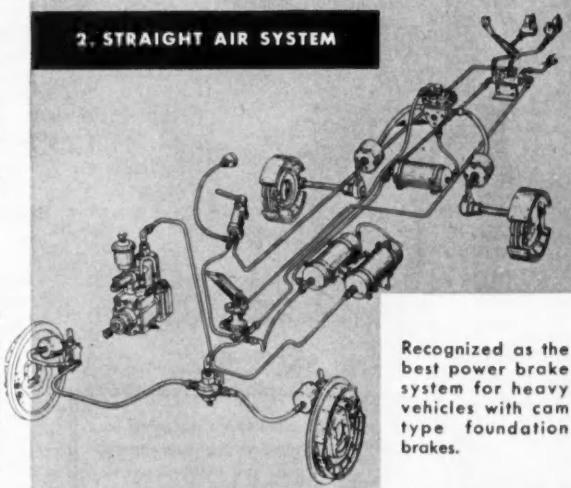

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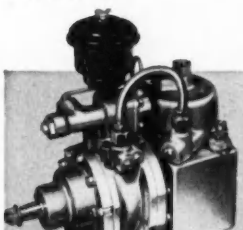

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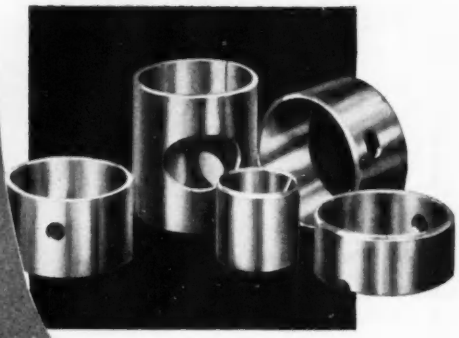

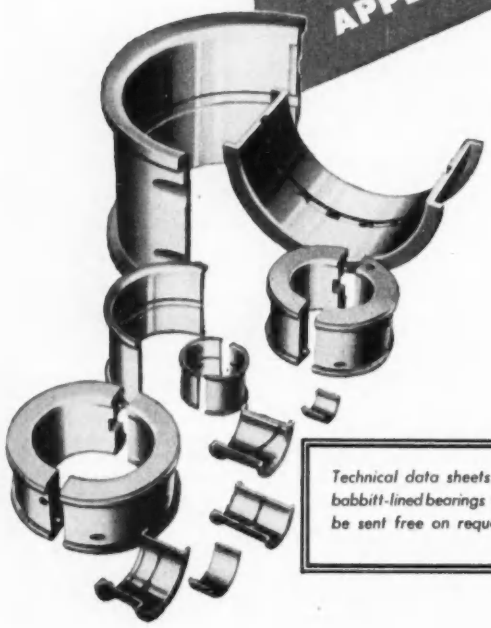

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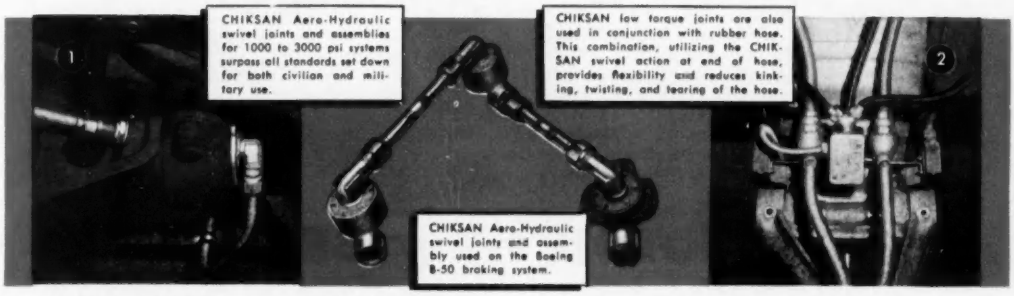
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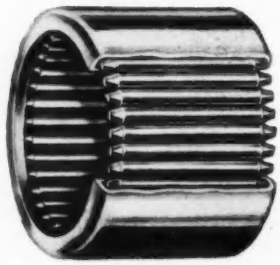

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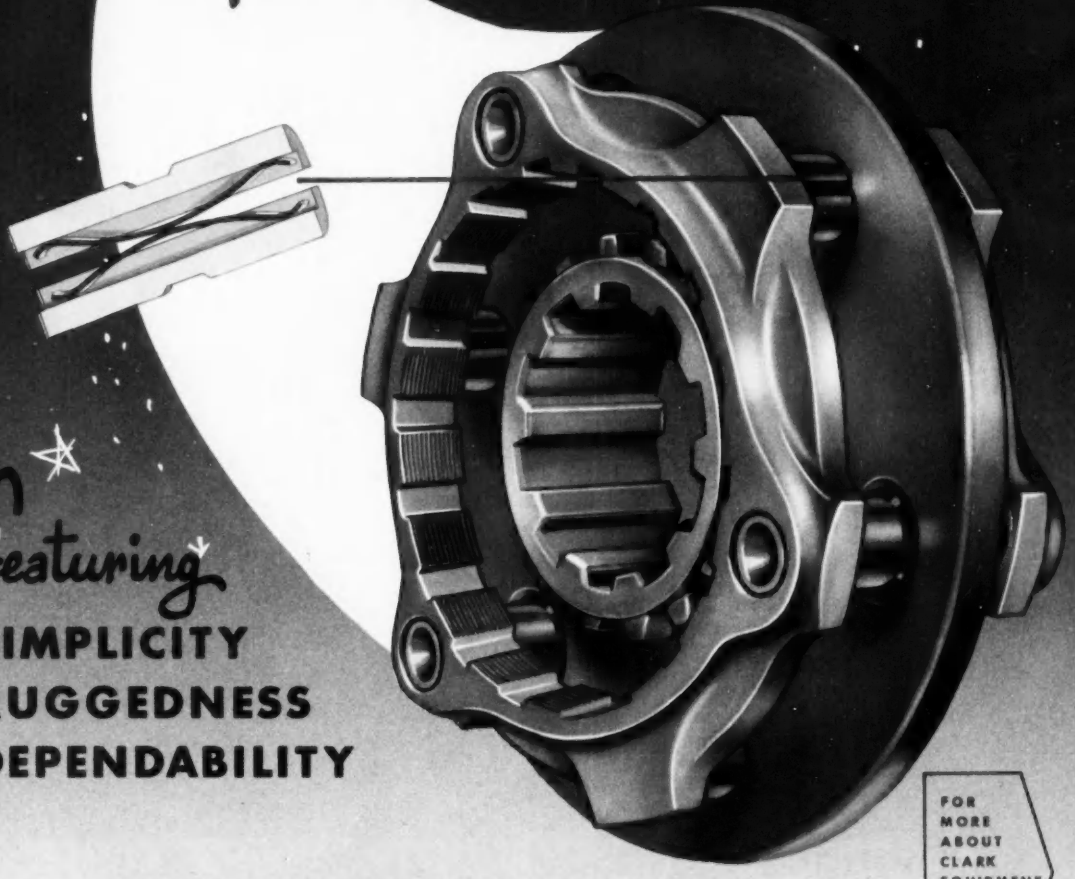

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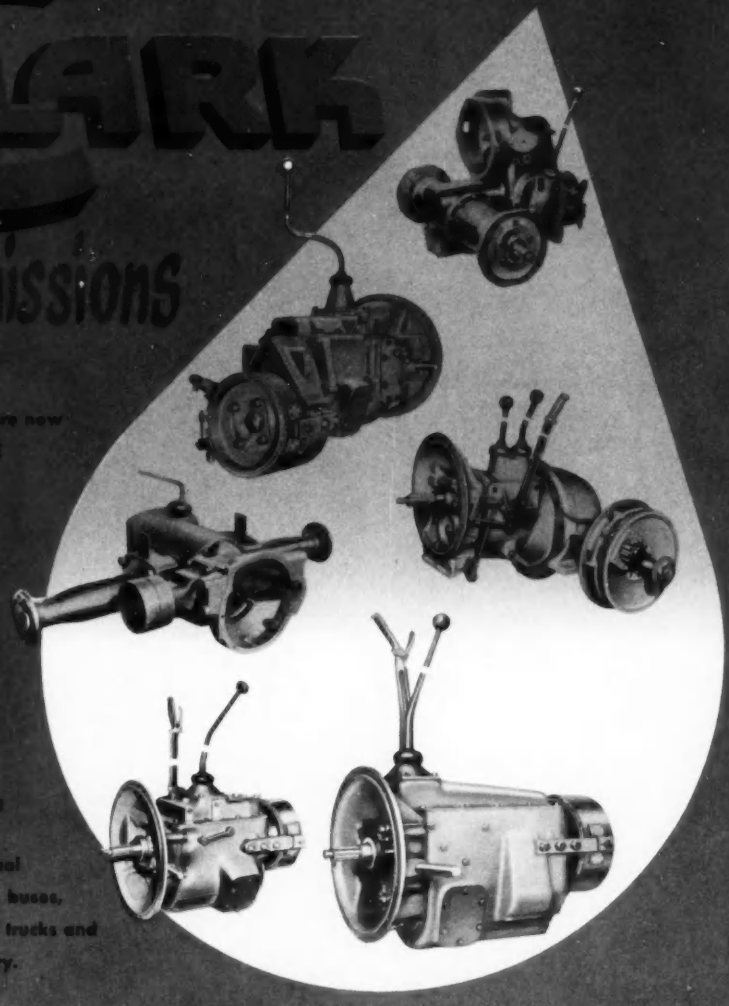

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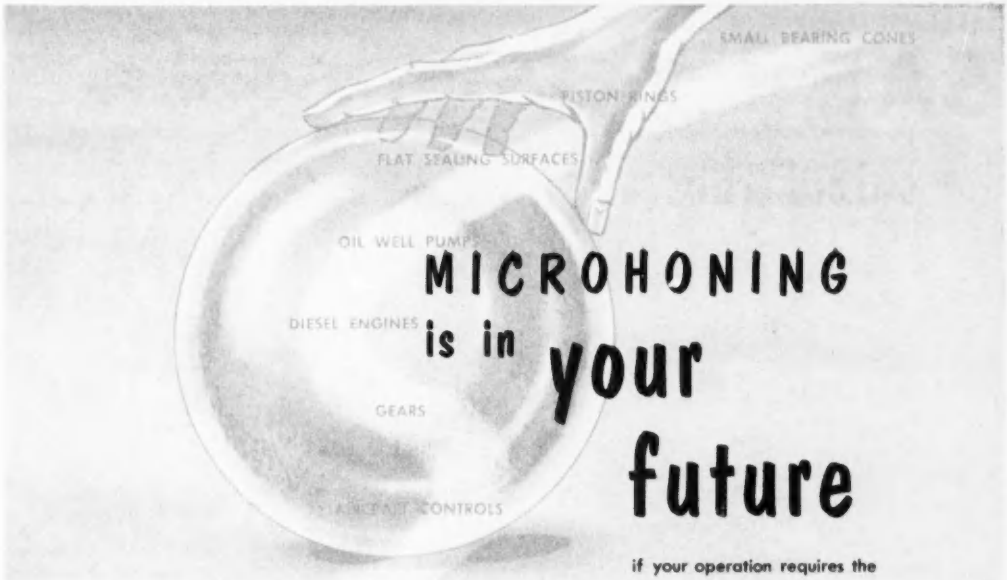

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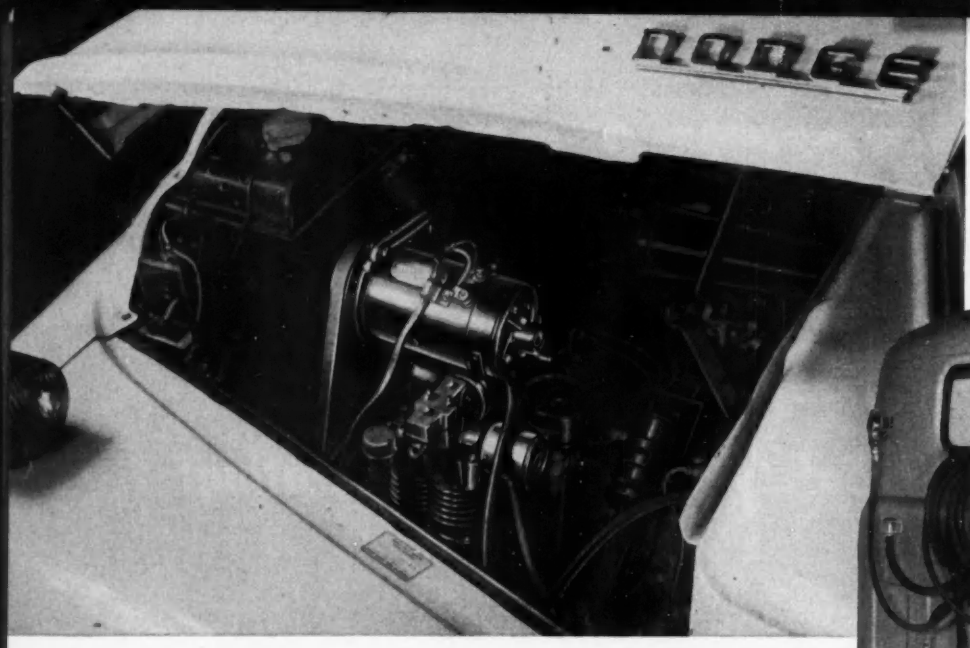

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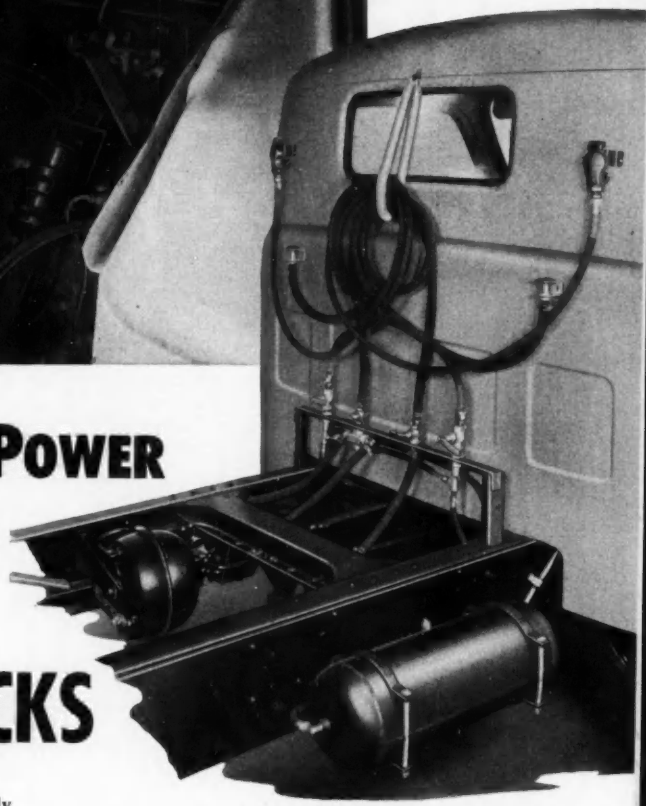

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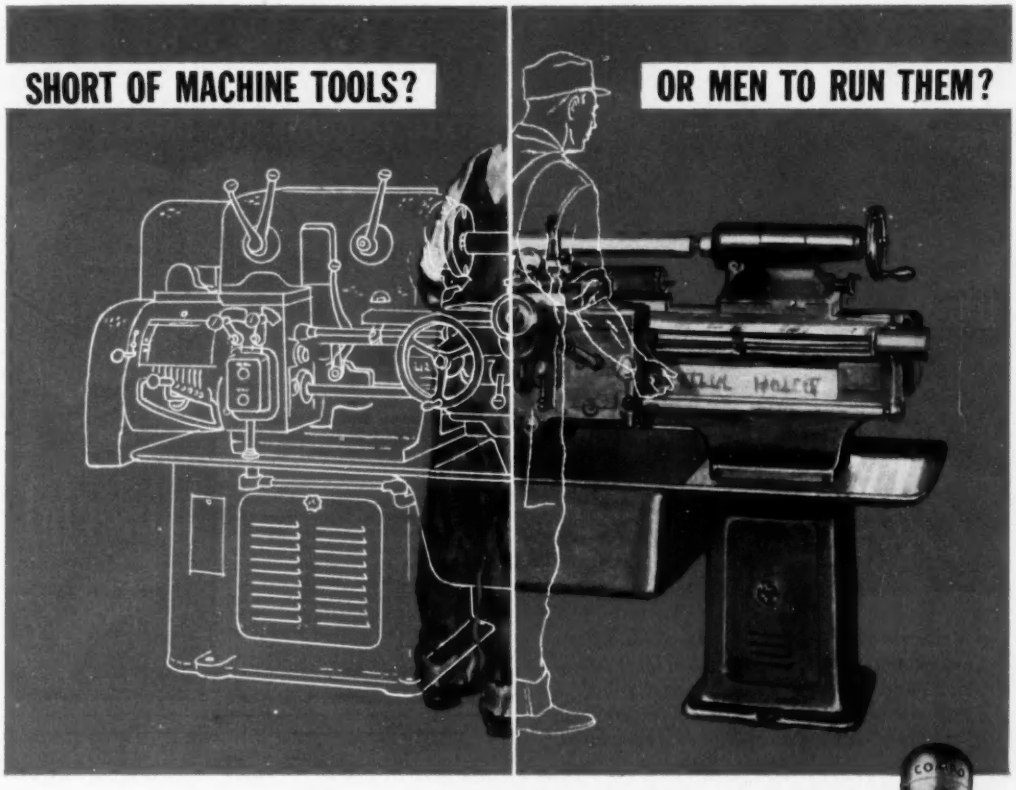

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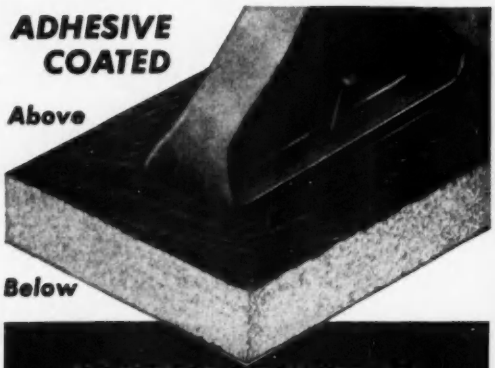

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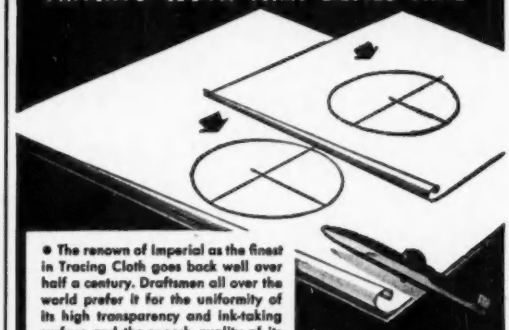

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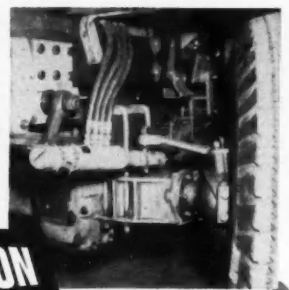

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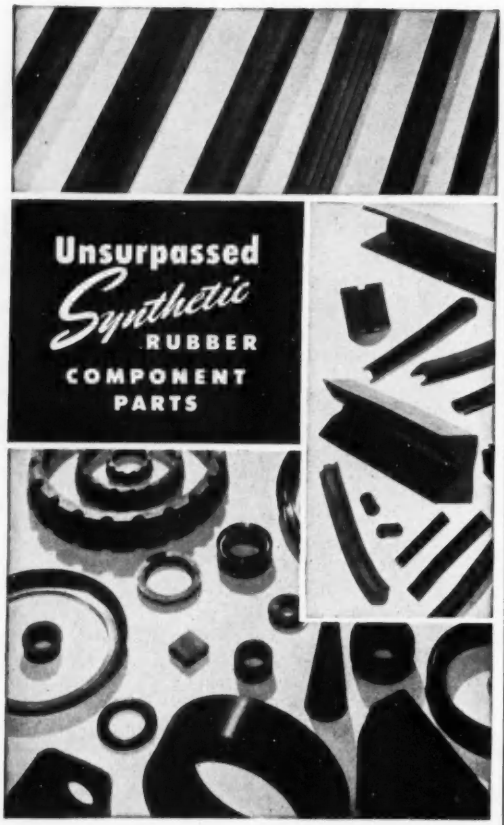

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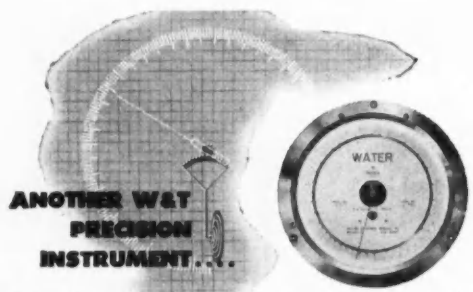

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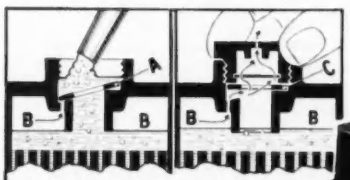
help make your customers "battery happy"



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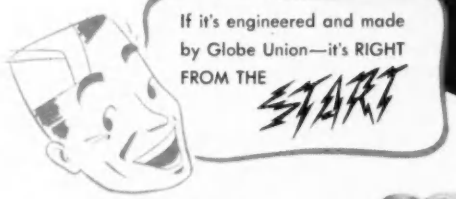

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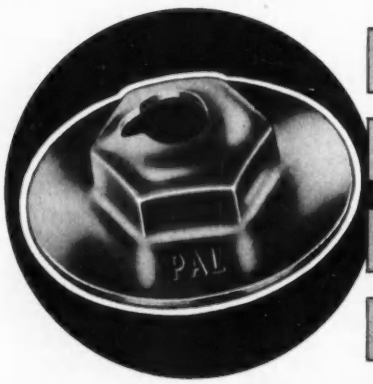

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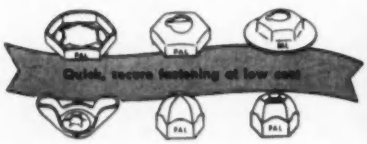

PALNUT TRADEMARK LOCK NUTS

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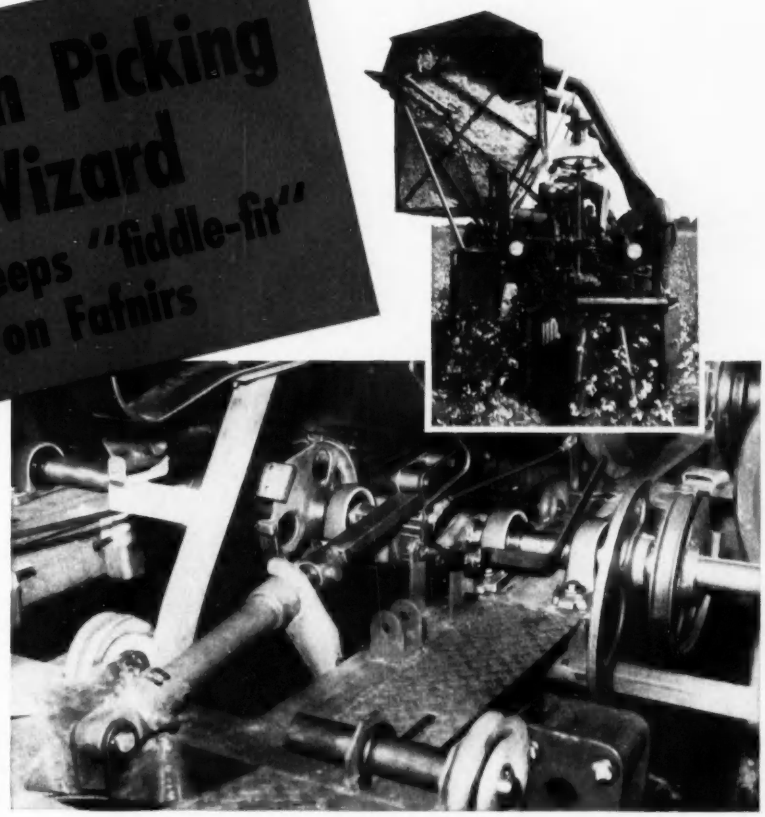


This view shows 4 Fafnir Pillow Blocks on main lifting shaft which raises entire weight of picker mechanism when operating over uneven ground . . . and 2 Fafnir Radials on idler pulleys.

You know how important it is to have a piece of equipment in shape and ready to use on the best harvesting days. With Fafnir Ball Bearings at many major turning points, Rust Cotton Pickers are equipped to render such service.

Fafnir Ball Bearings, sealed and shielded for retention of lubricant and protection against dirt and moisture, assure easy starting, efficient transmission of power, low power consumption and long service life. They have helped Rust Cotton Pickers to earn a reputation for extremely high capacity and crop recovery plus low-cost operation. On six hundred Rust Pickers operating from one to two years, not one Fafnir Ball Bearing has failed.

More than just good bearings account for this successful application. Fafnir engineers have worked with Rust designers, right from the start . . . a typical example of the Fafnir "attitude and aptitude". Maybe these attributes can help you find a better, cheaper way to use bearings. The Fafnir Bearing Company, New Britain, Conn.

FAFNIR BALL BEARINGS USED ON RUST PICKERS

The Unique Flangette . . . with pressed steel flanges and Mechani-Seals

Standard Radials . . . with Mechani-Seal- or Plya-Seals — (lubricated for life)

Pillow Blocks . . . featuring the famous Fafnir Wide Inner Ring Bearing with Self-Locking Collar . . . easiest of all to install.

FAFNIR

BALL BEARINGS

MOST COMPLETE LINE IN AMERICA

Make these hard parts better with 52100 steel

1. Diesel injection pumps
2. Lathe centers
3. Slitting rolls and knives
4. Cam rollers for automotive steering gears
5. Machine tool parts
6. Pump parts
7. Aircraft engine parts
8. Mechanical seals
9. Saw mill rollers
10. Ball bearings
11. Asbestos disintegrators
12. Mill rolls

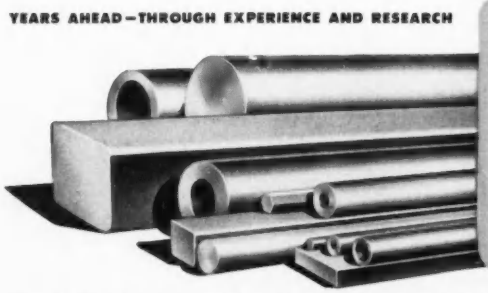
Because it's hard and tough—yet easy to machine—52100 steel is ideal for the parts you see listed above. 52100 was originally developed for ball bearings. It is now used for a wide variety of machined parts where exceptional strength and wear resistance are required.

52100 is a high carbon chrome alloy steel with high tensile strength and high fatigue strength. Because of its fully spheroidized structure, it machines easily. 52100 steel produced by the Timken Company will withstand a working pressure of 200,000 p.s.i. and can be oil quenched to a maximum hardness of 65/66 Rockwell C.

The Timken Company is one of the world's largest producers of 52100. And no other company offers 52100 in *all three* finished forms — bars, tubes and wire. To meet your small run or emergency needs, the Timken Company maintains a mill stock of 101 sizes of 52100 tubing—from 1" to 10½" O.D. And because the Timken Company controls quality rigidly at every step of production, you're assured of uniform quality in every shipment.

For a stock list of available sizes, grades and finishes, write The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH



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